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# THESIS

UNITED STATES TECHNOLOGY TRANSFER
TO PERU AND VENEZUELA

by

Alfredo Arrisueno
and
Ramon Peraza

December 1985

Thesis Advisor: J. W. Creighton

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However, the resultant transference has been quite uneven in its geographical impact, and there is a concern that the "technical gap" bewteen the developed countries and the less-developed countries is widening.

Concern about the widening of the gap and the need to increase the technology transfer process, is the very essence of the economic growth and development needs of less-developed countries.

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# United States Technology Transfer to Peru and Venezuela

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This Thesis will examine this gap, and an attempt will be made to determine guidelines, initiatives, and mechanisms to facilitate the transfer of U.S. technology to Latin America and specifically to Peru and Venezuela.

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# I. INTRODUCTION

Peru and Venezuela, because of their geographical position, have traditionally been greatly influenced by the United States (cultural, economical and technological) both in the civilian and military environment.

Historically also, Peruvian, Venezuelan and most of the Latin American military, have a very active political participation. As it is widely known they have occupied the presidency of their countries during long periods since the independence wars.

This political participation has given them the opportunity to study and participate actively in development programs where technology plays a leading role, both in the military and civilian environment.

On the other hand, the constant and increasing presence of officers from the Army, Navy and Air Force in Technical, General Staff, War Colleges and Postgraduate Schools in the United States, as well as contacts with the U.S. Military Missions and Mobile Training Groups in these countries, has given the Peruvian and Venezuelan military commands a good perspective of the existing technological gap and the need to implement an adequate transfer of technology process not only to the Armed Forces but most of all to civilian

organizations and enterprises, both government and private, in order to reach their national development goals.

But the crux of the problem in this technology transfer process between the United States of America and Latin-American countries is the ever-widening impasse that has resulted from the growing gap between Latin-American demands for technology and the inadequate supply response of U.S. enterprise groups.

This Thesis addresses this problem as well as the continuing set of issues between the United States and Latin-American countries over the transfer of technology processes. Many of the problems and barriers for the implementation of adequate programs in Peru and Venezuela, apply in varying degrees to other Latin-American countries and to newly industrializing nations of the Third World.

At issue is the basic conflict between emerging national objectives in Peru and Venezuela, Latin-America and elsewhere to utilize the technology factor as a pivotal element of national economic growth and development and representatives of the United States business enterprises who feel harassed and threatened by the new policies and their impact on commercial corporations in these countries.

In particular, United States firms with equity investments or licensing arrangements object to what they consider as infringements on their industrial property

rights and upon their latitude to manage commercial operations.

Peru, Venezuela and other Latin-American countries are pressing for the restructure of the Technology Transfer environment at both the national and international levels. Along with other developing countries they are seeking to establish an international binding code of conduct to govern transnational enterprise relationships.

The tendency in this area of controversy has been to engage in mutually incriminating and often acrimonious dialogue, rather than to seek positive and mutually advantageous solutions. Part of the problem lies in a failure on the part of the United States to fully understand and appreciate the new set of development policies underlying the drive toward greater technological independence and self-sufficiency. On the other hand, in Peru and Venezuela and in almost all Latin-American countries, there has been an unwillingness to accommodate to the commercial realities relating to the management of technology assets from the supplier's viewpoint.

Commingled with the commercial consideration of United States enterprises are broader questions of United States international trade and technical assistance involving its Peruvian and Venezuelan neighbors. These economic and political considerations must also be factored into adjusted

relationships based upon a new parity of interests and objectives.

The alternative is to run the risk that the perceived impasse between United States commercial and economical interests and Peruvian and Venezuelan national development goals will deteriorate into a mutually destructive political and economic confrontation. The way lies open to reformulate the trade and commercial relations so that they continue to benefit segments of the United States economy, while at the same time respond to the emerging aspirations and perspectives of Peruvian and Venezuelan societies.

The overview and analysis of the shift in Peruvian and Venezuelan policies, and the new types of arrangements that United States firms are entering should prove useful to involve segments of the United States business community for the formulation of its foreign policy toward Peru and Venezuela and the rest of the Latin- American countries.

The enlarged demand for industrial technology on new terms, coupled with continuing efforts by Peruvian and Venezuelan economies to expand exports of manufactured goods to the United States and other world markets, poses new challenges for adjustment and accommodation between United States policy regarding domestic production and employment and international relationships with newly industrializing nations like Peru and Venezuela.

This thesis provides an examination of the Technology Transfer Process and its importance in Peruvian and

Venezuelan national economic development, that applies to both civilian and military environments, the measures recommended to enhance their technological absorptive and self-generating capabilities, and some insight, guidelines, and recommendations on the nature and direction these adjustments and accommodations might take, based upon mutual interests and advantage in order to make Technology Transfer a mutually beneficial process for the United States of America, Peru and Venezuela.

## II. CHARACTERISTICS OF THE LATIN AMERICAN SOCIETY

### A. INTRODUCTION

Technology Transfer, is a process that has strong links with the culture and the characteristics of every society. Therefore it is the intention of the authors to make an analysis that will cover the most relevant aspects of the Latin American Society, and of two specific countries, Peru and Venezuela. The following aspects will be covered:

1. Origin and Evolution of the Latin American Society
2. Today's Society
3. Religious Characteristics
4. Major Types of Latin-American Executives

### B. ORIGIN AND EVOLUTION

Latin American Society is a mixture of three races White, Indian and Negro. Although ethnic background was an important criterion of status in colonial times, it became less so as "mestizaje" (the genetic mixing involving various combinations of any of the three) made distinguishing between racial types increasingly difficult. Eventually, ethnic categories came to be regarded as points along a continuum rather than as discrete entities, and physical appearance and skin color became a major criteria for determining status. Even though this area has proven

conflicting in many other countries, in Peru and Venezuela no national census has classified the countries according to ethnicity.

At the beginning of the sixteenth century, the territory that is present-day Venezuela and Peru were inhabited by indians of different groups of widely varying cultures and linguistic affiliations.

The spanish conquest resulted in a rapid and widespread extermination of indigenous groups. There are no reliable statistics available and hence it is impossible to estimate the loss of indian life in the first years of spanish rule. Those that survived were subjected to economical and political control and converted to Christianity. Mission outposts were founded by various religious orders. A system that dispersed groups of Indians and forcibly resettled them in accessible towns under the supervision of church authorities was known as "reducciones" (reductions). Under another system, the "encomienda" (in charge of), individual colonists were given the right to collect tribute from Indians within a specific territory in return for undertaking their religious conversion. Each of these systematic methods of pacification made a profound cultural impact on the native people.

By the end of the sixteenth century, the role of the Indians in the national ethnic structure had been fully set and the previously most populous tribes were virtually

extinct, their surviving members subject to bondage under the Spaniards [Ref. 1].

As the agricultural economy flourished, and the indian population diminished, the colonist turned to importing African slaves to meet their needs for a cheap source of labor. Large numbers of slaves were imported from many ethnolinguistic groups in the sixteenth to the seventeenth centuries.

Although in many instances the black slaves were mistreated and worked under inhuman conditions, they had a social and legal status that was vastly different from the slaves in British colonies. Whereas a slave in North America was considered the absolute property of the master, who could not be held responsible before law for any mistreatment, the Spanish colonial system provided several means of recourse for a slave who felt ill used. Homicide and physical cruelty to a slave were legally punishable, even if commited by the master. In addition, any slave who established that he had been badly treated could demand in court that he be sold to another master. And, whereas Anglo American law held that a slave had no civic rights -being the equivalent legally of a nonperson-Spanish American law gave him the right to contract for binding marriage and to own, bequeath, and dispose of property. In general, spanish colonial law encouraged manumission, the act of releasing

from slavery or servitude; whereas North American law was designed to discourage the freeing of slaves [Ref. 2].

The result of this legal and social tradition of slavery was the rapid growth of a population of freedmen working as manual laborers in the cities or living as peasants on marginal lands.

From the outset Venezuelan and Peruvian social structures were static and rigidly stratified along classes and color lines developed under the influence of Hispanic values and the Roman Catholic Church. A small number of more or less pureblood white occupied the top rung of the social ladder by virtue of their status as landlords and preservers of the Hispanic heritage. This heritage stressed the importance of the patriarchal extended family, the primacy accorded individual uniqueness and dignity, the disdain for manual work, and the distinction between the roles of males and females. Machismo, the complex of beliefs and attitudes that came to define masculinity, stressed chivalry, virility, courage and daring, and played an important part of both countries socio-political development. It was a vital ingredient in the personality of caudillos who governed after independence and today is a deeprooted value in the society.

A small middle stratum was made up of less successful whites and those mestizos who were able to gain some

education or wealth. Engaged as clerks, traders, teachers and petty bureaucrats or in the forms of nonmanual workers, members of the middle stratum usually lived in urban areas and emulated the values and behavior of the upper class as closely as they could.

The lower class was rural and largely undifferentiated; the majority of its members were poor peasants, usually of pure or mixed Indian or African descent, and their lifestyles reflected the amalgam or cultures they inherited.

Hispanic influence was found at the structural or institutional levels in such things as local government, the spanish language and the Catholic Religion. Restricted by skin color and poverty, and frequently by law, the lower class could not fully adopt all the values and behavior patterns of the upper class and so formed a folk culture that differed in several aspects. Among those, the matriarchal system was chosen instead of the patriarchal.

As time evolved, both usage and law reinforced the rigidity of the social structure and the distance between the classes, where the whites considered themselves to be innately superior to their non white compatriots and took every possible measure to maintain social distance. But in the eighteenth century, Spain's crown began selling "dispensas de color" (color dispenses) which allowed their purchasers to enjoy the prerogatives and status of white men, regardless of social background. From here stems a widely used proverb of "El dinero blanquea" (money whitens the skin), and this eventually contributed to the liberalization and relaxation of discriminatory practices based solely on skin color. When the independence wars were fought, all types of classes were intermingled for the fight for freedom [Ref. 3].

C. TODAY'S SOCIETY

Before the oil and mining eras in Venezuela and Peru began in the mid -1920s, about 70 percent of the population was rural, illiterate, and poor. Over the next fifty years the ratios were reversed, at least to the extent that more than 75 per cent of the population became urban and literate. No social group has escaped the impact. Accelerating opportunities brought large number of immigrants, increased size and power of the middle class, feelings of cohesiveness, and the creation of a sector of organized workers within the lower class.

The upper class was quick to see the advantage of a growing economy and soon took over the fields of commerce and industry, moving to consolidate its wealth through urban pursuit. Upper class dominance in the economic sphere somewhat inhibited the ingress of a middle sector. As a consequence and in view of the tenuous hold the upper class exercised over the political system, the middle class found a greater access to mobility through political power and soon solidified its hold on the government. It is demonstrated by the fact that most of the presidents, civilian and military have come from the middle class. The polarity that developed between political and economic power blocks and the orientation of each, came to reflect the differences in the social origins [Ref. 4].

D. RELIGIOUS CHARACTERISTICS

Actually some 90 percent of the people in Venezuela and Peru are baptized in the Catholic Church. As a result of missionary efforts 2 percent of the population is protestant. A small number of indians continue to practice their rituals and religions but some of them are still adopting Catholicism.

Relations between the church and the state have been harmonious throughout most of the current century and have continued to be peaceful up to the present. Due respect is accorded to the church through its representatives, who are always guests at all important ceremonial functions. Clergy are not barred from politics but they have gradually defined their role in society in accordance with recognition of the state's preeminence.

One of the most significant and important area of church involvement in the Venezuelan and Peruvian societies is in education. Catholic schools have traditionally educated the children of the middle and upper class (because of high tuition fees). Since the 1960s, attempts have been made by the hierarchy of the church to establish some control over the schools, to encourage the admission of a greater number of scholarship students, and to increase the number of schools with little or no tuition. The results in the 1980s have been that more than two thirds of the Catholic Schools

and Colleges are tuition free in some regional areas or competitively priced in the more populated regions.

Even though the image of the church's role has changed in the public view, traditional attitudes and reactions toward religion show little modification. Venezuelans and Peruvians continue to practice a kind of Catholicism that adheres only loosely to church doctrine but is deeply emotional. Laxity in practice is widespread, as is a low level of general knowledge of the basic tenets of the faith.

Of the various elements of religious practice, those with a more solemn aspect are less popular than weddings, baptisms, and the celebrations of saint's days (today it is still a big event in the less populated areas), all of which provide the opportunity for social contact in a festive atmosphere. Frequently the religious significance becomes secondary to social concerns. Moreover, affairs sponsored by the most affluent become occasions for a considerable degree of ostentation, as is usually indicated by the resultant criticism from the church's hierarchy.

In all classes, religion is regarded as properly the sphere of women. More conscientious in religious practice, within the family they are expected to assume the duty of religious and moral education of children. For girls early training is followed by close supervision in accordance with the socially protected status of the female sex. On the

other hand, boys because of a "Machismo" believe, are somewhat sort of discouraged from religiosity. Moreover, as experience and contacts outside the family circle increase, this attitude becomes more firmly fixed.

In the university environment, where liberal and communist inclinations are strongest, antireligious influence is especially great. Many times marriage and other social engagements might lead to a greater compliance with outward form, but its basic view toward religious practice remains unchanged. Although devotion is not openly criticized, it obviously is not a positive element in the Latin American ideal of masculinity [Ref. 5].

## E. MAJOR TYPES OF LATIN-AMERICAN EXECUTIVES

### 1. Constitutional President

Perhaps the most distinguishing feature of the Constitutional President is that it has existed in greater numbers than is widely believed. One of the most commonly-used terms with reference to Latin-American politics is "dictator". To be sure, there have been many dictators through the years, but there have also been a great many presidents who have taken over official duties and conducted these duties within reasonable bounds of constitutional directives [Ref. 6].

A number of conditions are necessary for satisfaction of this classification. Elections must be

constitutionally acceptable, and a reasonable reflection of the popular will taking into consideration the retardation in such matters as suffrage and reality of public opinion that exist in many republics. It must be understood that this condition does not bar the eventual constitutionalizing of a regime established initially by a coup d'etat. Establishment of power may be necessary for the fulfillment of constitutional conditions. At a suitable time thereafter, however, legitimization of a proper sort must follow. It is not easy to assess the propriety of this step in all cases. When is a coup legitimized properly and when is it legitimized under intimidation, for example ? There is no sure formula widely applicable. One may perhaps safely judge that the legitimation of the National Revolutionary Movement in Bolivia in 1952, when Paz Estenssoro took over the presidency, reflected a genuinelly-popular sentiment since he had received a plurality of votes cast in the election at issue. On the other hand, Batista legitimized himself in 1954 under strong intimidation of Cuban opposition groups that left considerable doubt as to genuineness. A government of doubtful status itself can pave the way for a constitutional regime. For example, General Odria's government established by force in Peru in 1948, and latter supposedly legitimized by an election in 1950, made its way under the shadow of a surpressed popular party (the

Apristas). By 1956, however, this party was allowed some freedom and the election of Manuel Prado qualifies, in the main, as a constitutionally proper one. The same phenomenon occured in Venezuela where Colonel Marcos Perez Jimenez stayed in power for almost ten years.

To satisfy the requirements of this type it is also necessary that the opposition be given freedom to contest elections reasonably and to express its views regarding policy-making as well. Again, we encounter difficulty in interpretation and must resort to a realistic appraisal of local circumstances. Thus, in spite of the opposition's continous cry of fraud and imposition, the Partido Revolucionario Institucional (PRI) in Mexico must be granted a place of legitimacy in this respects. The PRI must be viewed for what it is - a very large confederation of political groups within which the ordinary differences of politics are fought out, similar to the Democratic Party in some U.S. Southern States. There is considerable difference between the PRI and the Colorados of Paraguay or the Partido Dominicano of the Dominican Republic, to mention the other major examples of one party domination in the Latin American area. It is a difference that touches upon aspects of the formation of opposition from effective party organization to the various phases of the electoral process, and including the effective pressure of opposition in the various media of

communication. A very crucial criterion is of course the application of laws affecting the freedom of expression in its many forms [Ref. 7].

The fraternity of constitutional presidents does not include those executives who have unreasonably maneuvered constitutions to extend their tenure of office beyond the spirit of the constitution. The practice of "continuismo" is not in harmony with Latin American constitutionalism and it is particularly at variance when it involves that version by which a president-dominated constitutional assembly, after drawing up a new fundamental law, proceeds to appoint the incumbent to serve as president under the new system. This disqualification does not extend, of course, to a proper constitutional amendment relating to extension of tenure if the incumbent then is elected to the office.

Finally, it should be observed that to occupy the post of constitutional president, personalism must be confined to constitutional limits. When a president, however legitimate originally, climbs to a pedestal and creates himself as an order above the constitution, particularly if he actively sponsors a cult center on his person, he has violated the spirit of Western constitutionalism. The constitutional president must be conscious of his heritage in this aspect and exercise restraint.

There is a strong correlation between republics supplying the larger number of constitutional presidents and the political awareness evident among the great mass of people in those republics. The awareness is in turn dependent upon well-known economic, and educational advantage. The most constant in this regard have been Chile, Costa Rica, Mexico and Uruguay. In the second rank may be placed Argentina, Brazil, and Colombia.

Ecuador, Guatemala, Peru, El Salvador, and Venezuela have shown occasional promise; Bolivia appears to be enjoying an introduction.

2. Demagogic Caudillo

The Demagogic Caudillo has not yet appeared frequently, but it is a highly spectacular type that warrants attention because of the very modern touch involved. It bears some similarities to European Fascism, although it is not generally as extreme. There are a number of distinguishing features that serve to give this type a standing of its own. Argentina affords the best example during the years that Juan Peron dominated the scene.

The first characteristic of the demagogic caudillo is a very close relationship with constitutionalism. It emerges in a system that has deep commitments to constitutional presidencies in the past. The demagogic caudillo can easily win legitimation by elections. He rises

above constitutionalism not necessarily by violation of electoral laws but chiefly on other grounds. The proper habitat of this type is the republic with a high degree of political awareness founded on an economic order of considerable productivity. A key to the power structure is a large industrial worker's movement of such massive power that it becomes an aggressive reflection of popular support. It must be constantly wooed and rewarded even to a point beyond the attention customarily given to the military and which, until the structure weakens, can be used effectively to stand off strong military opposition. The maintenance of such a system of mass approval calls for extraordinary powers of organization, diversion and communication. One of the weaknesses of the system is the difficulty of keeping mass support alive, for the mass appetite grows and becomes increasingly difficult to satisfy. Since the leader has committed himself to the role of saviour of the worker and since increasing adulation of him soon transcends the more mundane spirit of the constitution, the cult of the Leader results. It is this, characteristic that most closely resembles the European totalitarian systems of recent memory [Ref. 8].

Excessive nationalism, with the implication that Latin-American leadership is involved, together with heavy doses of anti-Yankeeism, is very important to the pattern.

One of the distinctive touches is ideological in nature. The Leader becomes the symbol of the ideology-preferably a "new way" like the supposedly-new course by Peron's "Justicialismo". The demagogic caudillo takes the old complaints and declares that he has solved them by a quasi-messianic summoning of the greatness of the people.

The demagogic caudillo represents a curious combination of regressiveness and advancement. He is of both worlds, old and new. He is regressive in that he builds firmly upon ingrained authoritarism and creates a gigantic monument to personal leadership; he is a symbol of advancement in that he has realistically appraised a modern industrial society, wooed and won mass support, and undertaken a social mission in keeping with the twentieth century's demands.

The prototype of this type of executive was, as mentioned, Juan Peron. Vargas of the 1930's merits some consideration but his claim to real legitimation was rather poorly-founded until his return in 1950. Peron was popularly-elected in 1946 and again in 1952 and it is clear that he would probably have been elected on both occasions without the intimidations practiced by an enthusiastic party following. He was raised to heroic stature and from this eminence he clearly operated beyond the intention of the constitution. It would not be correct to label Peron as a

product solely of Latin American caesarism, or as the "duce" of a totalitarian system, or even as a military dictator. He was each of these in some measure but principally he represents a new departure, a leader with the characteristics of a constitutional president who, however, soared out of the constitutional cage into a personal venture so high as to allow for no safe return.

At the moment there is no demagogic caudillo in any of the Latin American republics. If one were to explore potentialities and engage the risk of speculation, there appears only one real possible candidacy and there are many reasons why it might not develop. This possibility is Fidel Castro of Cuba. Cuba fits the pattern fairly-well in terms of socio-economic pressures reflected in voluble mass sentiments. It lacks the major ranking that could justify pretensions to Latin American leadership, but this could be outweighed by the image of Castro as a revolutionary leader already possesed of heroic stature. Castro could ascend to dizzy heights of personalism, particularly if there were added some of the provocations that attended the rise of Peron in Argentina.

3. Military Guardian

The setting for the military guardian is the republic of major or medium power in economic terms wherein an appreciable - if not substantial - political awareness

has been generated. Usually the political scene has been sufficiently-active to provide for a number of political parties. One of these parties may be the vehicle of considerable popular sentiment for reform; its strength is potentially great enough to make a bid for power and, indeed, it may have done so only to be thwarted by perhaps illegal methods. One of the sociological factors of this setting is invariably the lack of a large middle class actively seeking change. In such a sociological situation, the military have usually been a political determinant. In the period since the end of World War Two, excellent examples have been found in Colombia, Peru, and Venezuela [Ref. 9].

Against this general background, there may be viewed the various thought patterns of the military officer intent upon political power. Military guardians may arise in an endless variety of combinations of local political considerations, but there are two major justifications cited by intervening military leaders that demand particular attention: Order and Neutralism. Ordinarily, these are found in combination and are closely related. Order is, of course, a major preoccupation of the military profession everywhere. In Latin-American republics, there occur many opportunities for using this as a justification, although often the intervention of the military goes well beyond the demand of

the situation. More common in the ranks of military guardianship is the complicated motivation that might be said to result in a defensive military guardian. In this maneuver, neutralism is cited in order to protect the national dignity, honor, and traditions from the excesses of the masses. Stated more bluntly, this is a last stand against popular government that threatens the old order. A large popular party presses forward with the electoral power to sweep into office; the language of reform fills the air. The military guardian comes forward to "save" the republic from this mass "chaos". The best examples were in Peru and Venezuela where the Apristas and Democratic Action, respectively, had demonstrated enough power to win elections. Accordingly, General Odria in Peru and General Perez Jimenez in Venezuela intervened and suppressed the parties at the gates. Both leaders stated that it was time to save the masses from their own ignorance, or words similar in meaning. General Odria, indeed, stated this most colorfully when he announced that "party politics poisons the hearts of the people and sickens their minds". One is reminded of Thomas the Cynic in Ignazio Silone's "School of Dictators" who stated that in socially-backward countries "the army constitutes the only barrier against the so-called anarchy of the popular masses and the corruption of the politicians" refprd 10 This belief has been entertained by

many Latin-American military guardians. The stated aim is "neutralism" but the result is suppression of popular will.

All military guardians are, of course, driven by some degree of personal yearning for power. The military-officer class in a typical Latin-American republic is a considerable reservoir for political ambitions. A leader of this class may be given an opportunity sooner or later to cite one of the ancient justifications for military intervention and thus launch a political career at the head of the republic. The military guardian, in our time, stands ultimately at the mercy of the popular movement he wishes to delay. Both Odria and Perez Jimenez have given way to constitutional presidents, although the circumstances of their withdrawal differ considerably; Odria presided over an election and Perez Jimenez was ousted from office.

4. Paternalistic Caudillo

In the paternalistic caudillo we find a type that was most widely evident in the nineteenth century before the onset of industrialism and associated effects. At the present time, Paraguay, belongs in this category. Two decades or more ago the paternalistic caudillo flourished in most of the Central-American republics in spectacular fashion. As the title of this type indicates, the system of government resembles a large "hacienda" with strong superimpossition of the "patron".

The paternalistic caudillo is, indeed, a national "patron". He may in fact posses large holdings in property and control a number of basic industries. Nepotism is especially evident in such a system; the total holding of the caudillo's family connection will be staggering. The paternalistic caudillo carries to an extreme a long-entertained notion in Latin-American political life: the possesion of political power is a concession and the concessionaire manages as large a return as possible (much of which may be quite legal, or "honest graft" as it is sometimes called in the United States). The republic is in great part a private preserve. The caudillo need not be overpoweringly oppressive, although he protects his system with tightly-controlled military forces. He may be viewed by many as a great national father who takes care of his own, at least to the extent he feels is good for them. The caudillo usually openly indicates that he is exercising a tutelage over ignorant and child-like people who are not ready for the bewildering machinery of a free system.Some of the major examples have been Anastasio Somoza in Nicaragua, Rafael Trujillo in Republica Dominicana, Juan Vicente Gomez in Venezuela and the actual president of Paraguay Alfredo Stroessner [Ref. 11].

There are two electoral features that characterize the administrations of paternalistic caudillos. The

technique of continuismo is employed to excess in such circumstances - that is, the application of domination to extend one's tenure beyond the intention of the constitution. The other feature has to do with alternation in office. A paternalistic caudillo's position is usually so secure that he can occasionally afford the luxury of allowing someone else a turn in the presidential office, perhaps a member of the family (as Hector Trujillo, brother of Rafael).

## III. TECHNOLOGICAL CHANGE IN LATIN AMERICAN COUNTRIES

### A. INTRODUCTION

Is there a conflict between the people of a country and its scientific community ? We doubt it very much. There may be conflict between specific interests among individual scientists, but surely this cannot affect the general agreement on aspirations and objectives of the people which is: to enjoy the fruits of science in terms of its technological applications for human welfare. Accordingly, it must be the responsibility of society, represented by the state, and the scientific and technological communities to work towards achieving this goal.

On the individual level, a scientist would be very happy to have a well equiped laboratory, an up-to-date library, assistants, and adequate funding. His happiness would be greatly increased were he to publish his papers in a well-reputed journal, preferably a foreign one, and discuss his results in international conferences, thus acquiring a respectable scientific record. A research centre would like to boast of a large assortment of modern units, in one or multudisciplinary areas, recognized as the largest in the country or region. A central agency could satisfy its pride by showing that a given country has so many thousands of

scientist or so many hundreds of qualified researchers per million inhabitants. All this is very fine. It is a national and scientific obligation to acquire high levels of scientific excellence, but this excellence provides only the potential for benefit for the people until the science based results are produced and applied. The excellence should result in the welfare of the people of that society rather than an unrealistic excellence facade that can only serve foreign interests or those of individual scientists, thus producing a number of serious consequences that could lead to technological dependence [Ref. 12].

Similarly, in industry one may be content to acquire a number of model plants. However the real measure of worth should be measured by whether:

1. The technologies used were a product of local indigenous capability and innovations.
2. The choice of the imported technology was made in full or even moderate awareness of what was available on the world market.
3. The requirements of the majority of the population are meet by this industry.
4. The possibilities of the national scientist system to assimilate, adapt, manage and develop such technologies were taken into consideration.
5. Whether the terms of such transference represent definite advantages to the economy.

B. SOCIAL RESPONSIBILITY

In order to cope with such complex problems, a national policy is needed in order to build up the Science and Technology System and ensure that it is part and parcel of the Development Plan of the country.

The main responsibility for this rests with the scientist community and its awareness of its social responsibility. In Latin American countries- as well as in other developing countries- the political leaders, due to different national and international considerations, and irrespective of ideological beliefs, frequently and freely express their hope to build their respective countries on the basis of modern science and technology as a major instrument for development, welfare and power.

Persistent trends to acquire a national science and technology policy are being increasingly well received, and practices for planning for science and its applications are being partially implemented with varying degrees of success. Contributions to the process of industrialization have been from the public sector, and education, as well as the experiences acquired in economic planning, resulting in great possibilities for the systematic contribution of science and technology in shaping the future of Latin American Society [Ref. 13].

## C. SCIENCE, TECHNOLOGY AND DEVELOPMENT

A development plan does not only concern itself with economic growth. Development is not just economic growth; it is growth plus change. In other words, the real objective of development is not to increase production, but rather to increase the capacity to produce. It depends on people with the outlook, knowledge, training and equipment to solve the problems posed by their own environment, and thus controlling the environment rather than being controlled by it. This capacity has grown in the now richer industrialized countries by a historical process, sometimes natural and slow, sometimes planned and even forced, often aided from abroad, but also always indigenous.

Thus the basic role of science and technology in the development process appears as a major instrument:

1. When it does not work in a vacuum but in response to the pressures of the demanding market functions, in providing new products or processes, or in providing improved ones for better quality or less cost, i.e. innovation production.

2. To increase the production and the capacity to change the modes of production, with serious impact on society locally and internationally.

3. To determine policies within the framework of a national developmental policy, and never in isolation.

4. Which cannot be wholly or substantially imported, but must be inherent in the structure of the society, its environment and the national heritage.

D. SCIENCE AND TECHNOLOGY POLICY

More than 60% of the people of the world live in less developed countries, and have average annual earnings of $150, contrasted to that in the industrial developed countries of $ 2,000 per capita. The annual rate of growth in gross domestic product (gnp= gdp - net income payments abroad e.g. income of foreign investment) of the industrialized countries is much higher than that of the developing countries. The annual rate of growth of population in the latter is around 2.8%, while that of the former is almost stable. Accordingly people in developed countries become increasingly richer, while those in the less developed countries become poorer. In consequence, the socio economic gap represented by standards and quality of life in basic needs of food, shelter, education, consumption of electricity, oil, minerals, industrial goods,etc. as well as in all kind of cultural and physical activities, between the developed and less developed world widens and steadily increases. The consequences are dangerous.

Approximately 97% of the world's R&D resources, outside the socialist countries, are spent by the developed countries. Of this, 35% -55% is devoted to military and prestige purposes, and less than 3% is allocated to urgent agricultural environmental and industrial problems of the developing countries. This clearly indicate the importance

given by the industrial advanced countries - which spend between 2% - 4% of their G.N.P on R&D - to science and technology, and how it is neglected by developing countries whose vast problems remain unsolved [Ref. 14].

To bridge the socio-economic gap, there is no alternative but to opt for science and technology using combined efforts from the developing countries, and assistance from the advanced countries. This means that developing countries must mobilize and promote their limited scientific and technological resources, properly orienting their potentialities for effective use within the national development process.

Targets can not be achieved without planning. No effective planing can be implemented without the formulation of a conscious science and technology policy refprd 14 This policy must be armed with the following:

1. A realistic outlook on the role of science and technology, separately and in combination.
2. A well-defined strategy regarding the socio-economic demand of the science and technology system.
3. A practical and manageable institutional arrangement for the formulation of such a policy and its implementation.
4. A clear concept of international collaboration.

Such a policy must be able to answer such questions as: how can we despite all obstacles and constraints, build up a national system of Latin American scientific and

technological capacity to use the wealth of available knowledge to improve production and services:

1. How can we solve the crucial problems which confront growth and progress?
2. How can we implant technology and alleviate technological dependence?
3. And, finally, how can we cope with contemporary advances in science and technology in the world system?

## E. THE ROLE OF SCIENCE AND TECHNOLOGY

Although science and technology have become interconnected, especially in the development process, a distinction between the two ought to be borne in mind.

A little over one hundred years ago, the social invention of the industrial research laboratory emerged. Before that, and even after, scientific discoveries on the one hand and inventions on the other had little to relate one to the other. Both usually took a very long time to find their way to industrial investment: photography took 112 years (1727-1839), the telephone 56 years (1820-1876), and the radio 35 years (1867-1902). But with closer relations between science and technology, between the scientific-technological system and capital investment, and between defense and economic policies. Diffusion periods were shortened: radar took 15 years (1925-1940), television 12 years (1922-1934), the atomic bomb 6 years (1939-1945), the transistor 5 years (1948-1953), and the integrated circuit 3 years (1958-1961) [Ref. &aas].

Science can supply the basic knowledge required for understanding the origins and dynamic of the problems, for measuring their magnitudes and directions, and for devising and assessing possible approaches to cope with them. Technology draws on scientific knowledge and can provide many of the practical tools and techniques for tackling the problems and applying the results. The union of them was finally accomplished by industrial research. This was also made possible by the action of and interaction with other important socio-economic instruments such as capital, laws of the market, education and training, and managerial capabilities.

Under such prevalent conditions, the outcome of the marriage between science and technology is innovation. It is today the most recent and valuable industrial force and commodity in world trade. Electronics and petrochemicals are a good example [Ref. 15].

It may seem unrealistic for poor, developing countries to undertake innovative research because of the formidable costs and risks. Yet, this is exactly what Japan has done and surprisingly it made it's greatest break-throughs in science-based industries. Japan was a poor country at the turn of the present century, with very limited natural resources; but it had great will and determination, a policy and a plan. Apart from the financial requisites, the

capability of the national science and technology systems to orient themselves toward realistic goals is essential.

It is clearly necessary to establish a sound infrastructure for national scientific and technological activities. In developing countries, which are usually poor in terms of qualified manpower, the scientific community encounters serious difficulties in convincing governments to allocate appropriate funds. The slogan that science and technology must be recognized as a sure investment for sure returns always need to be proven materially. In Peru and Venezuela, one frequently hears of the readiness of the president and ministers of planning and finance to provide funds equivalent to the annual loss of income resulting from specific problems in agricultural production, in health or in industry. It is our belief that relevance to socio-economic development should be the primary strategy and attitude of the science and technology system. Even in small laboratories or R&D units, concerted, alert and directed efforts to tackle a few problems through adaptive or development research would achieve great results. Such a strategy would reinforce the Science and Technology System and bring it to the forefront of national interest. We also believe that the science and technology system should embrace all scientific and technological activities.

## F. PROBLEMS IN SCIENCE AND TECHNOLOGY IN DEVELOPING COUNTRIES

### 1. Alienation of Outlook

One of the major constraints and obstacles which confront the national Science and Technology Systems in a developing country, and indeed in many countries of Latin-America, is the alienation of outlook which generally dominates the attitudes of the scientific community at large.

Very frequently, and by virtue of necessity, developing countries send their young abroad for study and training. In an overwhelming number of cases their research, even in fundamental science, does not pertain to problems endemic to their countries. Upon their return home, they continue along the same line of research, thus serving indirectly the interests of the developed countries rather than their own. The problem is much more aggravated through the natural cycle of their work particularly when they train younger scientists, inculcating them with the same attitude, consequently building up several centres of research lines alien to and at the expense of their own poor country. This represents a striking feature of an internal brain drain, for it reduces the limited potentialities for planning research programs relevant to development. It also represents an obstacle to policies of science geared to national interests [Ref. 16].

It may be true that such scientists do not intend to harm their own societies; most of them are nationalistic, and believe that by carrying on such important research they will bring prestige to themselves and their countries. Their research is related to international trends, and is published in leading professional journals. They attend international conferences and become recognized in international society. Some even dream of winning awards such as the Nobel prize. Thus, in the final analysis they in fact belong to scientific communities which may be alien in every respect to their own country.

In many cases foreign aid accentuates such contradictory tendencies. This is an additional reason for regulation and planning international cooperation schemes in developing countries.

A science and technology policy should consider these problems. One possible solution is to send scholars abroad expressly to study specific problems pertaining to national interest. These scholars should, of course, be well equiped with a deep understanding of national problems in order to become the linkers in the process of technology transfer.

2. Domination of Classical or Academic Traditions

In the majority of developing countries, the role of the universities is deeply influenced by Renaissance concepts, i.e. that they should be centers of excellence rather than institutions endowed with social responsibility. Universities in Latin American countries seem to be mere prototypes of typical North American universities, this despite the fact that these have undergone several changes in their own concept and systems.

It could be rightly argued that the primary research function of a university is to be primarily concerned with fundamental sciences. However, what is really questioned here is the choice of subjects for research. Developmental and applied research necessitate basic research. In developing countries, the concentration should be on applied research in the majority of cases, instead of trying to cope with the new trends in modern science. This aspect could also be a part of the phenomenon of alienation.

Another disastrous result in Latin American countries especially in Peru and Venezuela has been the conversion of technical institutes to classical university prototypes, instead of their extension or conversion into technological universities.

Another problem has been the increase of university education and its spread over different provinces of

countries like Peru and Venezuela. This is of a great importance and has positive values,but more emphasis on the new trend of technological education (high and medium) should have been strengthened and given more social recognition. Down play of the general myth of the university degree as an ultimate goal in itself instead of an instrument of progress would have helped the process of technological change.

The bureaucratic application of the laws and regulations of the University system such as admission standards and the measures for the promotion of teaching staff is even more ironic.

The social implications are deep and disastrous. One example is the deepening of a general fashion of academic degrees that have become a tool for social recognition. Thus great writers as Andres E. Blanco in Venezuela and Mario Vargas Llosa in Peru are generally referred to as "doctors" as if the title were more creditable than their genuine creativity.

The authors believe that the investment in education is a matter of priority for a country in its struggle for economic development. The investment in human resources through education is indispensable. The return on education investment, whether for short technical types of programs or long ones involving graduate education, should at least equal the opportunity cost lost by not making the same

investment in public works, agricultural development or welfare.

## G. TRANSFER AND DEVELOPMENT OF TECHNOLOGY

Industrialization has become the cornerstone of economic growth and development plans in developing countries. Naturally these countries see the transfer of modern and sophisticated technology from the vast pools available in advanced countries. A study made by the United Nations Conference on Trade and Development (UNCTAD) in 1972 estimated that, "the direct annual foreign exchange payments by the developing countries for imported technology are very high and have serious implications on their trade and balance of payments". It also adds that "the technology transfer to developing countries are themselves innappropiate both as to the factor use and product type. The large scale transfer of technology from abroad may inhibit the development of technology capability and thus make technology dependence on the developed countries virtually perpetual". A number of extensive studies were made by international agencies (especially UNCTAD), regional organizations as the Andean Pact countries (Pacto Subregional Andino) and other institutions and individuals. Many recommendations were worked out for an international code of conduct on transfer of technology, and the creation of new institutional arrangements for the transfer and

development of technology [Ref. 17]. The Declaration on the Establishment of a New International Economic Order adopted at its sixth special session by the General Assembly of the United Nations included:

> Giving to the developing countries access to the achievements of modern science and technology, and promoting the transfer of technology and the creation of indigenous technology for the benefit of the developing countries in forms and in accordance with procedures which are suited to their economics.

The Programme of Action on the Establishment of a New International Economical Order adopted at the same UN session included a special section (IV) on the question of transfer of technology. Due to its crucial importance, the problem was also included among the main agenda items in the United Nations Conference on Science and Technology for Development that took place in August 1979.

Because the subject of the transfer and development of technology from the United States to developing Latin American countries, and especially Peru and Venezuela is the subject of this thesis, it is important to stress the following four needs:

1. The Need for a National Policy for Technology.

Most developing countries have acquired a deep understanding for the need for development policies for production and services. In addition, there is a growing awareness of the importance of a national policy for

science. Science and technology are very closely linked, and it is evident that technology is nationalistic by its very nature. Inventions or innovations are usually products of local requirements and conditions, and then registered and protected according to national and international laws, and finally put on the domestic and world markets as commodities. It is thus inevitable that developing countries recognize the need for a national technology policy that integrates both science policy and the national development plan [Ref. 18].

2. The Need to Create a National Centre for Technology Transfer and Development.

Among the institutional arrangements universally recommended as a key instrument for formulating and achieving the objectives of a national technology policy, is the establishment of a national centre for technology transfer and development. UNCTAD, in its third session in Santiago on 16 May 1972, adopted a resolution (39 III) on the transfer of technology that called on developing countries to establish such institutions [Ref. 19].

3. The Need to Lift Limitations Imposed by Transfer of Technology Arrangements on National Scientific and Technological Capabilities

Very often, limitations exist in a wide variety of forms, each varying in intensity and impact. They greatly limit the diffusion of the dynamic impact of technology on

the national economy through their effect on the recipient's ability to choose or adapt technology according to local needs and resource endowments. They also restrict the development of the domestic infraestructure for research and development for both the local and international markets, and inhibit access to inventions or improvements to existing technologies on reasonable terms [Ref. 20].

4. The Need to Emphasize and Ascertain the Very Close Links Between Science and Technology.

The real link is an effective applied research and development institute, whether in industry, agriculture or medicine, with design and engineering at its core, together with extension services.

Without fulfilling these needs, a country could claim to have industrial plants, but not industry, by the same token, it could claim to have scientific institutes, but not science.

Two major issues arise in implanting science and technology. First, to implant science and technology in developing countries, the Systems must have the full participation from the outset of their national scientists, engineers, economists and sociologists in the process of importing technology. Participation should start and continue at all stages of project preparation. R&D activities could preferably be placed within the site, or in

an applied research institute. This procedure ensures that the Science and Technology System could adapt to the requisites of the imported technology; it could learn, digest and assimilate it and then adapt it to local conditions and objectives [Ref. 21].

Second, the Science and Technology System in a developing country would have to reverse current research emphasis, and concentrate on adaptive research and development, followed by applied and needs oriented basic research. To do so, the Science and Technology System must live with the problems when and where they arise: in factories, fields, hospitals, rural areas; and with people everywhere.

# IV. TECHNOLOGY TRANSFER

## A. TECHNOLOGY TRANSFER DEFINED

Technology Transfer is difficult to define as its meaning depends on the time at which the transfer was made, the people considering the transfer process and the intended usage. For the purpose of this thesis, Technology Transfer means:

> The process whereby technical information originating in one institutional setting (country) is adapted for use in another institutional setting (country) [Ref. 22].

The key words are "adapted" and "technical information". A very broad concept of technical information is chosen. The term is used in the sense that Donald Schon [Ref. 23]. defined technology as:

> Any tool or technique, any product or process, any physical equipment or method of doing or making by which human capacity is extended.

Technology Transfer is more than just disseminating technological information; it is a conscious effort to disseminate information in quantity, quality, and format for use by the recipient.

Samuel I. Doctors stated that technology transfer should be viewed as a political, social, and economic problem.

Although numerous papers have been written about technology transfer and some field studies have been conducted, it is difficult to obtain meaningful information on the process of transfer [Ref. 24].

Technology Transfer may be either vertical or horizontal in nature. Most agencies and organizations are more effectively organized for vertical transfer, which is, the application of a technical principle to produce a new product or process within the organization or discipline. Horizontal transfer is the application of a principle to products or processes in another discipline or institutional setting.

## B. THE IMPORTANCE OF TECHNOLOGY TRANSFER

Simply put, technology transfer is the application of technology to a new use or user. It is the process by which technology developed for one purpose is employed either in a different application or by a new user. The activity involves principally the increased utilization of the existing science-technology base in new areas of application as opposed to its expansion by means of further R&D. It provides the means by which elements of the existing science-technology based can be more closely coupled to the innovation process in order to spur productivity growth. The time span for the transfer can be quite short-a matter of days in case where the technology transfer may be directly

applied in its existing form to the new environment- or the process can extend to a considerable number of years in cases where extensive modifications of the technology, redesign or adaptive engineering is required to make the technology fit its new role, or because an appropriate user has not yet found it.

A variety of means is available to Transfer Technology, depending on the nature of the technology and the specific circumstance prevailing in each case. Methods range from licensing agreements, joint ventures, and turnkey factories to technical consulting, product sale, trade exhibits, and personal contacts. No single method is appropriate for all situations. The effectiveness of the different approaches in terms of the ability of the technology recipient to learn and to acquire increased technological know-how varies. Generally, those methods that involve considerable person to person contact and some measure of education and training are considered to be more effective approaches. Successful Technology Transfer therefore hinges, to a large extent, on whether effective communication is developed between the principal parties. Effective communication, however, is necessary but not a sufficient condition to assure success in Technology Transfer. Many other technical, economic, and social factors also have a bearing on the eventual outcome.

Technology Transfer is not new, it has been in existence for a long time. In the thirteenth century Marco Polo helped introduce to the Western world Chinese inventions such as the compass, papermaking, and the use of coal for fuel. It has been only in recent years, however, that a concerted and systemized effort has been made to transfer technology as a means to stretch the R&D investment, and to develop greater utilization of the existing science-technology base in order to generate greater economic impetus. Technology Transfer offers the opportunity to obtain a greater return from past investment in R&D, but is not an end in itself. Its importance lies in its ability to stimulate and strengthen the innovation process. As such it provides the means by which the rate of technology innovation might be increased. To understand the importance of technology transfer in the innovation process, it is necessary to look more closely at how technology transfer interrelates with innovation.

Much attention is being devoted to the subject of how to better manage the country's considerable technological resources. Technology Transfer and Technological Innovation represent two different aspects of the overall subject. Despite the fact that each topic has individually enjoyed wide attention in recent years, there nevertheless is a definite interrelationship between the two which is often overlooked or neglected in treatment of the subject. The

purpose here is to examine the interrelationship in order to achieve a better understanding of how these two concepts mutually affect one another. Viewed in their proper perspective, a better appreciation can then be gained of their importance on the national scale.

Because of the numerous "definitions" and interpretations of the meaning of "Technological Innovation" and "Technology Transfer", the authors think that the two concepts must be individually discussed briefly to help clarify their meaning. It should be realized, however that innovation and technology transfer are themselves subject to much research at present, giving rise to the currently imprecise definitions.

1. Innovation

Innovation refers to the series of activities which in effect delivers an invention or idea to its first acceptance and use. The innovation process is subject to the influence of many internal factors such as economic and political climate, competition, public opinion, market conditions, company management policy, and the availability of financial resources. As a result, the innovation process generally is evolutionary in nature, and typically expands many years. Innovation is by no means confined to the technological sphere but exists also in the arts and in educational, social, and political circles.

The principal interest here is Technological Innovation, the process of taking a concept, invention, or idea and developing a useful product, process or technique which gain initial acceptance in the market place or user community. Some authors regard technological innovation to occur in three major sequential phases. Others, consider the innovation process simply to be bounded in time by two specific events, the time of first conception and realization. The intervening time period between the two events constitute the innovative period. A summary of the innovation process goes roughly as follows.

Phase 1 is initiated at the time of first conception of an idea, recognition of a need, or discovery of an invention. First conception is then followed by a period of evaluating available knowledge and alternative methods to seek an economically and technically feasible means to realize the idea, satisfy the need, or apply the invention or concept as the case may be. Phase 1 then can involve additional research and development in its early stages where new techniques or processes may be investigated and hypotheses tested. Positive results at this stage then provide impetus for Phase 2 where more detailed technical and cost analysis, further technical development, and problem solving are conducted to establish the technical and economic feasibility of the concept. Establishment of

feasibility then leads to Phase 3 which involves engineering development, design, manufacturing, market analysis, marketing, and finally introduction into the market or to the user, at which point first realization is achieved, and the innovation process is considered complete. The wide diffusion of an innovation throughout the market it serves, further technological improvement, and its further adaptation to new applications occur after first realization. This time period is referred to as the postinnovative period [Ref. 25]. It might also be considered as the institutionalizing period.

It is important to note that innovation is initiated not just through the generation of an idea or invention, but can be stimulated from recognition of a need or technical opportunity. In fact, recent results from different researchers indicate that most successful innovations arise from need recognition rather than idea generation or intervention. That is, demand-pull rather than technology push was found to be the stimulus in most case of successful innovation. This does not imply that inventions and idea generation are not important in the overall innovation process. On the contrary, although need recognition is found to be the major stimulus for first conception in most successful innovations, many of these may not have succeeded without the benefit of inventions and ideas developed during the innovative period.

Because innovation is subject to many internal influences which are not controlable by the innovator, serendipity and luck play a significant role in determining success or failure. Consequently, the innovation process develops an evolutionary nature which is not amenable to strict management and control. This is evident by the relative disparity in time span between first conception and first realization of successful innovation. Battelle found that their limit sample of successful innovation nevertheless covered widely varying time period between six and thirty-two years for the ten innovations studied. The average time span for this ten cases was nineteen-years. Moreover, it was found that the innovative time period varies for different industries, technologies, product type, and means of financing [Ref. 26]. Thus, environmental factors determine to a large degree the chances for a success or failure of a particular innovation. Alternately, the chance for successful innovation are greatly enhanced if environmental conditions conducive to innovation are established.

2. Technology Transfer

In any discussion of technology transfer, one invariably must contend with the question of what is meant by technology. Technology has been defined simply to be the application of science. However, this definition is

inadequate. For instance, the dropping of a pin may be construed as application of the law of gravity to remove the pin from the hand to the wastebasket. However, this is not an example of technology. The imprecise nature of technology therefore rules against a precise definition. Perhaps a helpful approach is to distinguish technology from science. Whereas science is concerned with the increase of knowledge and understanding, technology is directed toward use. Whereas the result of scientific research is usually publication of a paper, the output of technological activity is a product, process, technique, or material developed for some specific use. Technology not only involves the application of science but also can incorporate inventions and additional research to some extent. Patents are more commonly the outgrowth of technology rather than of science.

The phrase technology transfer also suffers from ambiguity, partly because of the imprecise nature of technology, and partly because the word transfer naturally leads to the question from where and to whom? It implies the existence of a source of technology and a recipient or user. The technology source and the user are not necessarily within the same technical discipline, so that technology transfer often points to an interdisciplinary activity requiring the attention of people knowledgeable in several fields. The activity involves principally the increased

utilization of a proven technology base rather than its expansion through further research and development.

For our purposes we may consider technology transfer to be the application of technology to a new use or user. It may be a direct application or may include the need for adapting or tailoring the technology to its new use or user. An example of direct application to a new user is the introduction of the Israelian irrigation system to Venezuelan agriculture. An another example where technology was adapted to the new user is the introduction of the Peruvian potato into Europe. In this case an experimental effort was necessary to adapt the potato to local soil conditions, weather, diseases, pestilence, as well as consumer needs and preferences. The use of low frequency electromagnetic transmissions in airborne instruments for geophysical exploration is an example of a new application of a technology originally developed as a world wide navigation aid for ships and aircrafts. Hence, it is technology transfer since it represents a new use of existing technology.

Technology transfer should also be distinguished from research utilization or technology utilization, which refers to the transition of research results or knowledge into goods or services to satisfy some requirements or needs of the user [Ref. 27]. Technology transfer then may be

viewed as the process by which research utilization is directed to a new use or user. Alternatively, technology transfer can be regarded as secondary utilization of existing technology.

3. Why Technology Transfer

Technology Transfer then is really not something that has only recently emerged, but has existed in various forms for many years. It is only in recent years of austere research and development funding; however, that increased interest has developed in technology transfer as a means to enhance the effectiveness of research and development and to increase our utilization of the existing technology base for the technological change and progress needed to sustain our countries (Peru and Venezuela) economic growth. From a different perspective, technology transfer offers the opportunity to obtain a great return on past investment in research and development. As a consequence, the precepts on which technology transfer is based are unimpeachable.

The great promise of technology transfer lies in its systematization and organization on a national scale. However, the realization of the promise remain elusive, principally because of the innumerable technological, political, economic, social, and behavioral factors that affect the outcome. As concluded by Burns, "The mechanism for technology transfer is one of agents, not agencies" [Ref. 28].

Effective communication and interpersonal relationships are the most important factors contributing to successful technology transfer. But social sciences have not yet devised a way by which this principle can be practiced in a systematic or organized fashion. Furthermore, the human ego is notoriously resistant to management acts of control.

## C. THE TECHNOECONOMIC INTERFACE

The interface between the science-technology base and economic progress is a complex one buffered by strong social, economic, and political currents. Not everyone is able to work effectively at the technoeconomic interface level. Thomas A. Edison, famous for his inventive ability, for example, in pioneering the electric light system, is often considered the personification of an innate ability to move easely within and between the realms of science, technology and economics [Ref. 29]. Nevertheless, he still needed to rely on a number of close associates to help him pick his way through complex technological, political, and financial hurdles. To place the principal element of the technoeconomic interface in proper perspective, consider the following model:

1. The science and technology base provides the principal foundation for achieving productivity growth and economic progress. However, the science and technology base, if it is to contribute in any significant way, must be effectively coupled to demands of the economic sector.

2. Technological innovation is the key link between economic progress and the science-technology base. Innovative products and services introduced into commerce help stimulate high productive efficiencies that give rise to gradual economic progress.

3. A strong economy in turn generates growing capital resources, a portion of which is plowed back for reinvestment in more innovative ventures and further productivity gains. However, the link between technological innovation and the science-technology base, can not be taken for granted irrespective of the resources devoted to R&D.

4. Full exploitation of the science-technology base depends on ready access to and the effective use of the scientific knowledge and technical know-how already in existence.

There must be a conscious effort to utilize these resources through transfer and adaptation for improving the rate of technological innovation. Technological advances derived from the innovation process also contribute to an expanding science-technologic base, which in turn provides a strong foundation for further economic gain.

Of the four principal elements of economic growth explained in the previous model, perhaps the least recognized and appreciated is technology transfer. A major reason is the feeling that we have successfully gotten by in the past without concerted efforts to transfer technology. This outlook is tantamount to expecting that future conditions will mirror those of the past. However, world conditions continue to change. New patterns of international technology flow will develop. Rapid dispersion of technical and management skills will take place, bringing on increased

competition and shortened product life cycle. Demand for technological products and services will continue to expand in the face of strong competition for the R&D. The information explosion will be exacerbated. All these factors will make the conscious transfer and effective use of available technology even more compelling and too important to leave to chance if strong rate of economic growth are to be restores and sustained.

Technology transfer acts to strengthen the linkage between the innovation process and the science-technology base. However, the flow of technology should not be construed to be only one way, that is from the science-technology base. There is an equally important feedback link where technological progress resulting from the innovation process also acts to broaden the science-technology base in conjunction with the R&D input. In general, the balance, bilateral flow of technology is an important aspect of technology transfer if substantive benefit are to be realized by the principal parties involved. Although the one way flow of technology may produce transitory benefits, long-term advantages from technology transfer, whether at the industrial, national or international level, are sustained by means of a mutually beneficial exchange in which both the resource and recipient prosper.

1. The Interchange of Technical Knowledge

Because of differences among nations in technological capabilities, there a continual process of international diffusion of technology. Knowledge can be transmitted in various ways - by emigration of engineers and skilled workers, by export of goods and services, by licensing, and by direct investment, among others. Data are available concerning national receipts and payments for patents, manufacturing licenses and technological know-how between parent firms and their subsidiaries as well as between independent firms. Taken at face value, these data seem to indicate that billions of dollars in payments are involved, that the United States seems to be one of the most important supplier of technology to Latin American countries. Therefore it seems clear that technology transfer in the modern world economy is a very big business.

Moreover, technology transfer is an activity with very important economic impacts and implications. It has a major impact on the pattern of world trade and the balance-of-payments problems of individual countries, and it has a very important influence on the rate of economic growth in various countries and specifically in Peru and Venezuela. It is the purpose of the authors to describe

briefly what economist think they know about this impacts of technology transfer. In addition, certain aspects of the transfer process will be discussed, including the role of the multinational firm.

It is important to point out that, according to available studies, technology is currently being transfer across national boundaries is increasing. During the nineteenth century, 20 to 30 years often elapsed before a product developed in one country was produced in another country. For example, it was about twenty years after their introduction in the United States that the rotary printing press and typewriter were first introduced in Britain. At present, however, the imitation lag is much shorter-in many industries such as electronics, only a few years, on the average. For example, John Tilton's studies of the international diffusion of semiconductors during the 1950's and 1960's shows that the average lag between the time a major semiconductor device was first produced and the time when it was first produced outside the innovating country was about two years. Or consider the stainless steel razor blade introduced by Wilkinson, a British firm; within a year, American firms had competing products on the market. This reduction in the imitation lag is important, because it means that an innovating country will export an innovation for a shorter period of time than in the past. In a

relatively shor period of time, its new products may be produced abroad and perhaps even exported back to the innovative country.

2. Role of Multinational Firms

Another relatively new facet of the transfer process is the important role of multinational firms which have been responsible in part for the acceleration in the rate of international diffusion of innovation. Multinational firms transfer technology to foreign countries in a variety of ways. In those countries where they have plants, they train people as operatives and managers. Also, they sometimes stimulate suppliers to upgrade their technology. For example, pharmaceutical companies have helped local firms in less developed countries with the fabrication of dosage forms. In addition, multinational firms sometimes set standards for their competitors. For example, American electronics firms seemed to have applied considerable competitive pressure on European firms in the 1960's. Also, they sometimes establish overseas R&D facilities, which aid in the transfer of technology. Often they train users and provide service for customers. For example, in the computer area, IBM has transferred a considerable amount of important technology by training potential users, providing software a nd servicing computer installations in various countries. Also, whether or not a firm has a plant in a particular

country, the availability of its product in that country may be a form of technology transfer.

Many case studies of particular industries attest to the important role played by the multinational firms in the international diffusion of technology. For example, Tilton's study of the diffusion of semiconductors shows that of the major innovations in semiconductors in the 1960's, American subsidiaries were the first to produce about 1/3 of them in Britain and about 1/5 of them in France. In particular, subsidiaries of American firms were relatively quick to use silicon and planar techniques, and by competing strongly with established European firms, they were able to capture large shares of the market. In 1968, foreign subsidiaries had 44% of the market for semiconductors in Britain, 33% in France, and 22% in Germany.

Many case studies also describe the role played by the multinational firm in the transfer of technology to the less developed countries. It is important to recognize, however, that these firms face much more difficult problems in transmitting technology to the less developed countries than to industrialized countries. Many of the techniques of the multinational firms may not be suited to the less developed countries, with their plentiful unskilled labor, few skills, and little capital. Moreover, there is sometimes little incentive for multinational firms to adapt their

products, production techniques, and marketing methods to the conditions present in these countries. Unfortunately, less developed countries lack the technical capability to effect the necessary adaptations themselves. The technological gap is so wide that multinational firms find it exceedingly difficult to transfer many technologies to less developed countries; and when they manage to do so, the effect is often are restricted to narrow segments of the local economy.

3. Technology, Productivity and Economic Progress

The role of technology in the economic sphere is no less important, though perhaps less clear-cut, because of the many nontechnological determinants of economic progress. The widely used measure of economic progress is productivity, which is defined as output per unit of input. Productivity growth occurs when higher productive efficiencies are achieved. For the economy as a whole, higher productivity means better control of inflation, less unemployment, and a better quality of life in general. For the individual company, higher productivity means lower unit costs of products and increased market competitiveness. Similar to technological change, productivity change is the more meaningful descriptor of a nation's economic progress. The rate of productivity change is commonly used as an economic measure and is generally given in terms of annual percentage change.

It is clear that technological change is but one of many factors affecting productivity. Nevertheless, technological change is widely viewed as the single most important contributor to productivity gains because it generally leads to more effective use of labor, capital, and natural resources-the other principal elements of production [Ref. 30]. Because the results of technological change are not easily measured, estimates of their contributions to productivity growth vary in the 40-70 percent range [Ref. 31]. That is, roughly half of the productivity gains can be traced to technological advances that are reflected in improved manufacturing methods, materials, and machinery. By contrast about 15 percent of productivity gain results from capital formation, and approximately 12 percent comes from improved education and training of the labor force. Of the many input elements to productivity, then, technological advance appear to be the most effective avenue for fueling productivity growth. However, technological change is by no means synonymous with productivity improvement.

We can conclude therefore that technological change provides the most promising avenue for higher productivity gains. The continuing inflationary spiral coupled with the increased scarcity of nonrenewable resources will cause the price of raw materials to continue its upward trend at a fast pace, thereby limiting the potential for raw material

to contribute significantly to productivity increase. The present trend toward more government regulations for protecting the environment and the safety and health of the workers on the job will add to the social cost associated with the free-market economy and consequently will tend to lower future productivity gains.

Though technological progress may become even more important for achieving high productivity in the future, it must still be recognized that it does not automatically result in improved productivity. Only to the extent that technological advance is coupled to the process by which new and improved goods and services are introduced into the commercial market does technology contribute to productivity. The process by which technological advance is translated into competitive goods and services-technological innovation-is therefore a prime determinant of the effectiveness by which technological progress is translated into high productivity output in the national economy.

4. Technology Transfer in Less Developed Countries

Technology Transfer plays a fundamental role in the economic growth of the less developed countries. Clearly, one thing that they badly need is more efficient technology. Unfortunately, however, modern technology often requires considerable capital; and the less developed countries, with their low investment capability, find it difficult to scrape

up the required capital. Also, and this is frequently most important, the less developed countries find it difficult to copy and use modern technology because they lack an educated and skilled labor force, and have few good engineers, technicians, and managers.

More fundamentally, it is important to recognize that much of the advanced technology is really not very well suited to the circumstances prevailing in the less developed countries. Because the industrialized countries have relatively great amounts of capital and relatively little labor, they tend to develop and adopt technology that favors capital over labor. This technology may not be appropriate for less developed countries where there is little capital and lots of labor. Thus, it is very important that the less developed countries pick and chose among the technologies that are available in the industrialized countries, and that they adapt the technology to their own conditions. Mindless attempts to ape the technologies used in the industrialized countries can often result in waste and failure.

In industry, most of the new technology adopted by the less developed countries is taken from the developed countries. There is probably too little effort being made to devise new technologies more appropriate to conditions in the less developed countries, both because the less developed countries do not have the engineering and

scientist resource to attempt such work, and because such attempts have not been very successful in the past. In countries where the private sector finds it unprofitable to carry out research and development, government research institutes sometimes attempt to fill the void, but these institutes frequently devote too much of their limited resources to projects that are not closely related to economic development. In addition, productivity centers have been created in some countries to teach managers and supervisory personnel how to make better use of technology: such centers have helped to promote the diffusion of new technology in Peru (Servicio Nacional Tecnico Industrial) and Venezuela (Instituto Nacional de Capacitacion Educativa).

## D. BARRIERS TO INTERNATIONAL TECHNOLOGY TRANSFER

The authors think it is very important and helpful to think of Technology Transfer in the context of the user rather than the context of the supplier of the technology. The user's circumstances certainly determine the barriers to transfer as much as does the supplier's situation. From that point of view it is possible to identify four classes of Technology Transfer. First, technology transfer where the investment barrier in the receiver country is the major problem in introducing new technology. In other words, the capital resources needed to create the capability, really

determine the critical problems which must be overcome in transfering the technology. The second is the local application barrier for the use of the product in the local market where adapting it to the local market is the critical problem. Third is the adaptation barrier where the problem is in manufacture, where it is necessary to rescale or modify the manufacturing process, either to meet local market needs or the local scale of production. And, finally, there is the technical capability barrier typically associated with satellite manufacture. Here local technical capability is frequently at a rudimentary level, and the initial problem is to determine what level of technology can be pursued on a cost effective basis in manufacture of products or components to be imported to the original supplier of the technology.

1. Investment Barrier

Here, typically, the situation is one in which the technology is itself highly developed and very sophisticated. The cost associated with further advances in the technology is very great. And, typically, the cost associated with manufacturing the product involves high tooling expense and highly specialized equipment. Consequently, the small size of the user country, makes the returns on the necessary investment unattractive. At the same time, the supplier finds itself under continuing

pressure to increase the local manufacturing level of the product.

The critical problems in achieving Technology Transfer when the investment barrier is the major problem, are normally in manufacturing and quality control, not in product design or even in modifications to fit local circumstance. The most difficult task is to identify deficiencies in the specifications, because specifications are never complete. The primary response to this problem is a very intensive interchange of people , in which the country receiving the technology sends its experts to the manufacturing facilities of the supplier of the technology, so they can observe, work carefully with their counterparts, and learn how the product is manufactured. As necessary, the supplier also sends people to the receiver of the technology to help trouble shoot.

2. Application Barrier

This barrier is typically associated with the sale of materials and components where, in many cases, export sales are difficult, if not impossible, because the supplier can't transfer applications directly from its market to the user market. Three kinds of constraints impede export sales. One is that the scale of operations is quite different, so that a use which make economic sense in the supplier's country doesn't necessarily make sense in the user's

country. The second is that the vendor infraestructure, which supports an industry, is different in different countries with respect to availability of components, price, quality, assurance of delivery, etc. So, again, a trade-off between make and buy, will result in a different choice and in turn will affect technology transfer. And finally, in some cases the customer requires different features, quality, or performance. For all these reasons the economic advantage of the technology being transferred must be demonstrated in the specific context of the local economy of the country that is the potential user.

3. Technology Adaptation

The third barrier, technology adaptation, is frequently involved in transfer of technology to the suppliers of foreign manufacturing affiliates- those that will be serving the local market or some regional market, the Andean Market for example. The typical problem in this transfer is to optimize the suppliers designs and specifications for most efficient operation. It is necessary therefore to have technical talent at the users level in order to make the necessary modifications. These people must be thoroughly familiar with the manufacturing capabilities of their plant. They must be able to redesign the product both to optimize a specific manufacturing setup and integration with the local market. They must modify

specifications, materials and processes to what is economically most attractive in their particular circumstance. The most difficult part of this task is to understand which aspects of a specification are critical to performance. Because specifications are always in response to a mixture of economic trade-off, they have to distinguish one from the other in order to modify designs and specifications successfully.

4. Local Capability

The final barrier, local technical capability, is tipically associated with off-shore satellite manufacture. This mode of operation is chosen when the supplier is seeking very low cost, particularly by taking advantage of very low labor rates. Opportunities for this mode of operation are usually associated with less-developed countries. This arrangement is often initiated by choosing some part of a process, usually an assembly operation, in which investment is very low. The supplier of technology may start with a simple assembly operation, and with progress along the learning curve, increase the complexity and size of the assembly operation as cost benefits are discovered. In all likelihood they will move from assembly into fabrication as the local capabilities grow both within the plant and the supporting industrial infraestructure. Thus, the supplier helps the user to grow by introducing

additional funds and additional technology into the region. At the same time, as the local aspirations grow and change the supplier also learns more about what is available locally and how to take advantage of it.

## V. THE TECHNOLOGY FACTOR IN LATIN AMERICAN DEVELOPMENT

### A. INTRODUCTION

It is the intent of the authors to analyze in this chapter the actual situation and policies within most of the Latin American countries, where new developments, and new attitudes toward multinational corporations have emerged.

These policies focus on rapid industrialization based upon a new and revised access to foreign technology and rapid growth of internationally competitive domestic industries. Technological self-sufficiency has become a primary goal in the development plans, and the strategy toward that end encompasses the progressive transfer of engineering and management capabilities, rather than technology embodied in plant and equipment.

Latin American development authorities are now keenly aware that the key to long-term growth and development lies in acquiring the ability to design and engineer industrial systems, which in turn necessitates the development of indigenous capabilities in product design, process engineering and equipment design and construction.

There are several reasons for this new orientation in development strategies. One is that Latin-American economies have reached a stage of development where industrial

enterprises need to achieve substantial increases in productivity and competitiveness in order to sustain continued growth.

Industrial plants in Latin America, producing largely for tariff-protected, domestic markets, have been heavily dependent upon foreign licensing sources for technology, resulting in product designs and production systems that rarely are competitive in world markets. In the seller's market generally prevailing in protected economies, product design and production techniques are often stagnant and lag behind in terms of improvement and modernization.

The aforementioned tendency is intensified by the privileged position of subsidiaries of foreign firms and large national enterprises, both of which have easy access to packaged industrial technology, including trademarks, patents, processing techniques and equipment, and a full range of technical services and managerial systems. In addition, foreign owned firms are often able to bypass technology payment restrictions that smaller, local firms are unable to avoid, thereby placing the latter at a competitive disadvantage.

State-owned enterprises in Latin America also have much less difficulty in technology acquisition, since they have access to the financial resources and managerial talent needed to choose and negotiate for technology. In contrast,

smaller Latin American firms encounter difficulty even in searching for appropriate technology and in arranging for suitable adjustments in product design or manufacturing processes and equipment.

Latin America has been especially critical of foreign-owned and controled subsidiaries that bring with them industrial technology which obviates the need for developing indigenous design and engineering capabilities or supporting capital goods industries. Once established in an economy, foreign-based multinationals also preempt or stultify the development of indigenous industry because of their comparative advantage in management and technology. This is a lesson that most Latin American governments have learned from the Japanese experience, where, beginning in the early 1950s, the Japanese Government screened all foreign investments and leasing agreements to minimize the adverse side-effects of preemptive foreign presence or restrictive licensing arrangements [Ref. 32].

Technological upgrading is needed especially at the domestic enterprise level to meet increased competition at home and abroad. Technological upgrading involves new processing techniques, the use of new and improved materials, and the introduction of new and improved production methods. In some cases, this may involve more dynamic and aggressive licensing arrangements which break

the dependent linkages with single licensing partners and move on to more diversified sources of equipment, materials, product designs, process licenses, and hired technicians. A principal inhibiting factor has been the lack of financial resources and mechanisms to fund the purchase of technology from foreign sources and/or to obtain indigenous design and engineering support services. Improved access to technology sources and design-engineering resources can contribute significantly to increased productivity, and extended utilization of domestically available energy and mineral resources, and an enhanced competitiveness in world markets.

B. NATIONAL TECHNOLOGICAL DEVELOPMENT

Increasingly Latin American nations have resorted to interventionist efforts to restructure the demand for, and supply of, technology in their respective national economies and in the world economy at large. Programs and initiatives have related to each of the four functional sectors:

1. Government
2. Financial
3. Science-Technology
4. Business enterprise

Each of these communities impacts upon the transnational transfer and domestic utilization of technology. The nature and efficacy of involvements understandably vary from country to country depending upon the involved mechanisms

and programs, and the skills and capabilities of involved people and institutions.

It is the purpose of the authors to analize the relative function and role of each of these communities in Peru and Venezuela as follows:

1. Restructuring supply of technology (screening and control).
2. Restructuring internal demand for technology (planning, searching, and negotiating).
3. Reinforcing the absorptive infrastructure (training, supporting,, using and generating).

Until recently, most national mobilization efforts in Peru and Venezuela fell within the first category. Initial strategies to restructure the supply of technology were aimed at an international level and focused on obtaining international consensus on a Code of Conduct which would be binding on the actions of multinational corporations. This strategy also sought major revision in the international property system which, in the Latin American view, placed them at a disadvantage in acquiring foreign technology. Failure to obtain cooperative support in this strategy, particularly from the industrially advanced countries have led the developing nations, and in this case Peru and Venezuela, to incorporate legal and regulatory changes into their respective national laws regarding foreign investment and technology transfer [Ref. 33]. The two countries studied in this thesis (Peru and Venezuela) have instituted

programs to restructure the supply of industrial technology to domestic enterprises.

It is important to point out that for the purpose of this thesis, terms can be defined as follows:

1. Screening: Includes the monitoring, evaluation and assessment of foreign technologies.

2. Controlling: Includes restrictions on the inflow of foreign technology based on appropriateness to national development goals.

3. Planning: Includes policy coordination and project formulation.

4. Searching: Includes both creation of an information system and individual search and evaluation activities.

5. Negotiating: Includes activities of the parties negotiating and the new government monitoring role.

6. Training: Includes all activities related to know-how transmission through people.

7. Supporting: Includes services such as standard setting, patent registration and extension services.

8. Using: The ultimate goal at which any technology transfer system is aimed, includes research (basic and applied) and design and engineering of products and production systems.

## C. MYTHS AND REALITIES CONCERNING TECHNOLOGICAL DEVELOPMENT

Certain misconceptions concerning the nature of industrial technology and how it is derived must be dispelled if we are to deal realistically with the problems of technological development in Peru and Venezuela.

To begin with, science and technology cannot be packaged like any other commodity and dispersed by the industrially

advanced countries along with their other foreign aid. Science and technology do not come in convenient, self-contained units that can be packaged and shipped for use from one part of the world to another.

Technology as has been stated before, is derived from a continuum of of activities encompassing research, development and engineering, which in turn is often intimately linked to ongoing production and marketing activities. Most industrial change which includes the design and engineering of products themselves, the materials that go into them, the equipment that is used in processing materials, the work methods and management control systems is a continuing process consisting of a myriad of elements which results generally in small incremental changes [Ref. 34].

The diverse "products" of science and technology activities are often derived from unique social environments. Technology "products" are further linked to user environments that provide the signals for what is needed in the way of new or adapted products or processes.

Another basic misconception is that dependence on foreign technology may be substantially reduced or eliminated through the development of indigenous science and technology in universities and research laboratories. In reality, the extent to which technological selfreliance can

be achieved depends in large part upon the stage of industrial (and technological) development in a particular country. In the post-World War period, Japan depended heavily upon operational technology from foreign sources, gradually replacing foreign engineering and design with indigenous scientific and technological capabilities to supplement foreign imports. "Unbundling" (and redesigning and repackaging) was a basic technique used by the Japanese in their industrial evolution [Ref. 35].

A third misconception is that government-to-government aid programs can provide development of indigenous science and technology in universities and research laboratories which in turn can be channeled into the productive sectors. The fact is that rarely have the programs addressed themselves to the designing and engineering of "operational" technologies. One basic problem is that the lion's share of efforts go toward a long-term buildup of basic research ability, most of which is unrelated to the applied and development research that feeds into operational technologies.

A fourth myth is that industrial technology can be developed in university laboratories and industrial research institutes to help replace industrial systems traditionally supplied by foreign enterprise sources. The fact is that science and technology communities do not produce

operational technology packages. Furthermore, even if they did, the linkages between these communities and the productive sectors are largely ineffective. Science and technology communities can perform an important ancillary role in support of industrial design and engineering efforts to improve, enhance, or supplement foreign enterprise sources of operational technology, but they cannot be the major supply source now or in the foreseeable future.

Operational technologies will continue to be the products of enterprise units linked to technology generating units. The university community in the particular case of Peru and Venezuela can best help by developing human resources to take a more positive role in creative design and engineering activities.

## D. MANAGING TECHNOLOGICAL DEVELOPMENT IN PERU AND VENEZUELA

As Peruvian and Venezuelan governments have sought to intervene in the development process, they have inevitably infringed upon enterprise decisions governing production and marketing activities. In the technology field, administered guidelines and regulations have sought to lead (or compel) enterprises into new channels of supply (from indigenous sources to replace foreign suppliers) or to screen technology imports to eliminate restrictive clauses in foreign licenses to assure that the price paid is not excessive and to influence decisions in the choice of

technology "appropriate" to the national endowment and development goals. The inevitable difficulties (and dilemmas) lie in the basic conflict between commercial interests to maximize profits in price-distorted economies and the achievement of national developmental goals, which, if adhered to, would often reduce realizable profits and, more importantly, would seriously complicate the life of enterprise managers.

The fact is that "dependence" upon foreign technology is a form of risk aversion for domestic private enterprise, and the foreign patents and/or trade marks provide positive reinforcement to the effective exploitation of protected domestic markets.

In response to the foregoing dilemma, Peruvian and Venezuelan governments have increasingly turned to administered controls to intervene in technology markets. This has subsequently given rise to another set of problems. One is that technology markets are highly complex in nature and the sheer quantum of what must be monitored poses monumental tasks for government bureaucracies. Moreover, efforts to screen and control acquired technology, or to impose various restrictions on what should be bought and the amounts that are paid merely serve to reduce the supply of technology without offering commercially viable alternatives for technological development from within the economy.

Another dilemma concerns short-term gains versus long-term growth. National efforts to develop indigenous technological capabilities to make decisions without persistent dependence upon foreign aid, to negotiate more effectively for technology components, to adapt acquired technology as needed, to produce technology where appropriate, and to improve bargaining positions vis-a-vis foreign investors and other technology suppliers may result in production losses, at least in the short run. In the long run, however, a more dynamic and self-reliant technology structure that reaches into production systems can contribute significantly to productivity (more efficient and extensive utilization of available resources) as well as to the general level of employment and national output. Difficulties and frustration in national policy formulation are inevitable if government authorities fail to recognize the trade-offs in this area, but insist instead on having their cake and eating it too.

## E. UNITED STATES RESPONSE

In response to this new set of national development objectives involving the technology component, both in Peru and Venezuela, a number of U.S.-based companies have been entering into technology transfer agreements that are significantly more responsive than in the past to the emerging demands for new modes and content in technology acquisitions by the above mentioned countries.

The new generation of agreements reflects, in part, some of the profound changes that have occurred in the world economy, as well as changing perceptions of certain U.S. corporations as to how they may use their technology assets and know-how in new and more imaginative ways, and at the same time continue to earn a return on their corporate assets.

These innovations in corporate involvements center around the technology component of industrial systems, but they also involve profound adjustments in international marketing and production strategies of involved companies.

From the corporate perspective, the attractions of equity investment in, and managerial control of, foreign facilities are waning. A growing number of multinational corporations have now decided that the risks associated with overseas capital investments have become too high for realized rates of return. Aside from political uncertainties in a widening area of the world and especially in Latin America, there are the economic vicissitudes brought on by world inflation, exchange rate evaluations, and recessionary cycles, all of which have added to the risks of locking into fixed investments in a world of changing circumstances.

These uncertainties have been compounded by the fragmentation of world markets resulting from import substitution behind tariff barriers and regional trading

blocs as a partial offset to the inefficiencies of protected national economies. The growth of host country restrictions, regulations, and limitations on foreign investment has also tended to detract from this traditional mode of overseas involvement.

Another feature of the new technology-sharing agreements is the buy-back arrangement whereby the supplier agrees to accept partial payment in product. Once regarded as a necessary evil for market entry or retention of market share, these arrangements are coming to be viewed by foreign corporations (U.S. and Europeans) as a hedge against import restrictions and exchange controls remitted earnings.

In some cases, companies find offshore manufacture of components and parts less costly than in their original factories and, in those cases, have a double incentive to enter into buy-back arrangements.

Another factor which has contributed to the accommodating response by U.S. corporations has been the progressive advance in bargaining power that some Latin American countries, and among them Peru and Venezuela, are now able to exert in negotiations with multinationals. This enhanced bargaining leverage is derived from a variety of new conditions, any one of which in and of itself, is not necessarily determining; but, combined, result in a marked shift in the balance of bargaining power between technology

suppliers and purchasers in favor of the latter. The shift in bargaining leverage is attributable in part to the proliferation of alternative sources of industrial technology from Japan, Western Europe and even Eastern Europe.

The supportive interventionist role played by almost all Latin American governments in the technology transfer process also has enhanced the bargaining positions of Latin American enterprises. Peruvian and Venezuelan governments have adopted a variety of other supportive roles, ranging from acting as prime negotiator and purchasing agent in technology transactions to the erection of government agencies to screen and control incoming technology and capital investments.

Both Peru and Venezuela have begun to use their mineral and oil resources as leverage in acquiring industrial facilities and know-how to process their resources for world markets.

Another factor which has contributed to the shift in bargaining leverage has been the perceptible upgrading in recent years of the knowledge and skills which technology purchasers in less developed countries like Peru and Venezuela, bring to bear in negotiation sessions with multinational corporations.

## F. NEW GENERATION OF TECHNOLOGY-SHARING AGREEMENTS

The new generation of technology-sharing agreements is significantly more responsive than traditional licensing and investment modes to the emerging demands by countries like Peru and Venezuela for new types of and content in technology acquisitions. Under these new arrangements the international competitiveness and self-generating capabilities of personnel in the adaptive engineering process is an invaluable contribution to the self-reliance that Peruvian and Venezuelan governments have been so anxiously seeking.

Binding arrangements to export a percentage of production output assures that these domestic enterprises are meeting internationally competitive quality and performance standards, and (to the extent that export prices reflect costs) international cost competitiveness. An overview of the principal changes that have occurred in the marketing, production, and engineering fields in Peru and Venezuela follows:

### 1. Changes in the Marketing Function

With a view toward improving the productivity of resource utilization and balance-of-payments positions, many development authorities have called for moving national enterprises from the shelter of protected markets, characteristic of the import substitution phase of

industrialization, into more competitive environments of regional and world export markets.

This has placed considerable demands upon technology suppliers to assist enterprises in less developed countries in the logistics of international marketing and distribution. One significant innovation which U.S. corporations are making in this area is to permit purchaser enterprises in developing world countries to channel their products to world markets through their own highly developed and efficient international marketing systems. From the developing-nation viewpoint, this provides reassurance about the economic efficiency of installed plants and equipment.

A second significant change taking place in the marketing function of the new technology-sharing agreements has been the granting of trademark rights by U.S. corporations to the purchaser enterprise. The benefits derived by the newly industrializing nations are both practical and psychological. By committing its trademark and logo, a U.S. firm is, in effect, guaranteeing that the final product will be as good in every respect as any product coming off its own production lines. This means that the technology purchaser can anticipate the transfer and constant updating of those production methods and product design modifications which comprise the U.S. firm's latest technology. This situation requires that the U.S. company

spend an extraordinary amount of time training workers of the purchasing enterprise in production techniques so that the product can be interchangeable with that which is manufactured at the firm's other plants.

An important distinction needs to be drawn here between the above-described situation and the practice among multinational corporations of fully exploiting internationally recognized trade names and logos in less developed country markets. In the latter case, the product is typically manufactured in an owned and controlled operation of the multinational, located either in the home country or in a less developed country. Such products frequently constitute overwhelming competition for locally designed and manufactured products, carrying unfamiliar trademarks. It is this situation which has prompted development authorities in Peru and Venezuela to require that goods produced under international licenses and carrying foreign trademarks also be marked with a local trade name and logo. In this way, it is hoped the public will come to associate those products as much with a national company and national capabilities as with a foreign multinational.

A final innovational dimension in the marketing function encountered in some of the new agreements is the buy-back arrangement. Under buy-back arrangements, the

technology supplier agrees to accept partial payment for the technology in product, rather than monetary compensation, which is then distributed to the supplier enterprise's worldwide customers or subsidiaries. The overriding value to a less developed country enterprise of such arrangements is the guaranteed level of exports. Such exports make the technology transfer process a self-financing proposition. Above and beyond being assured the means of paying for the technology transplant, the purchaser enterprise is guaranteed a hard currency buyer of its product.

2. Changes in the Production Function

The new technology-sharing agreements obviously represent a radical departure from the traditional approach that United States corporations have taken toward managing technological assets in Latin American countries. In the past, it was only late in a product's life cycle once the production techniques had become generally available that the corporation was prepared to release technology. Today, however, and because of the new attitude of Latin American governments and the competition from Japanese and European corporations, a growing segment of U.S. industry is prepared to sell available technology. Its release is often under terms that assure rapid and efficient implantation of an internationally competitive production capability.

Acquiring internationally competitive technology and production systems (high-volume, cost-efficient, and quality-controlled products) is particularly compelling to newly industrializing nations like Peru and Venezuela, in that it permits the saving or earning of sorely-needed foreign exchange (through either import substitution and/or export promotion) with which to further expand and upgrade industrial production. Earning of hard currency is also critical in light of the debt burden now carried by Peru and Venezuela.

In addition to providing a scope and level of technology which permits quick entry into world markets, another innovation in the production function evident in the new agreements is the training component. Often such arrangements are accompanied by intensive educational and technical programs designed to create a self-sufficient manpower base within the country capable of managing and operating the newly acquired plants or production processes.

A final and extremely significant change taking place in the production area has been the ancillary function performed by some U.S. supplier corporations in the progressive development of domestic capital goods industries and related supplier plants as contributions to overall industrial growth and development. The development of forward and backward linkages has been an integral part of

several of the new agreements, laying the necessary base for self-sufficient production.

3. Changes in the R&D Function

The contribution to indigenous design and engineering capabilities is another important innovational dimension that must be considered as a result of the new agreements. These capabilities are viewed as essential skills needed to adapt foreign product designs and production techniques to indigenous factors of production and, more importantly, to generate their own technology. Training in design-engineering is often imparted through contracts calling for joint execution of plant engineering.

Joint research efforts oriented to the development of new product designs or processes for eventual entry into world markets also represent a departure from the way R&D is traditionally carried out.

Another change which is also extremely supportive of the development objectives of the country's industrializing nations is the structuring of enterprise relations so as to wean the less developed country's enterprises from foreign technology sources. Engendering technological self-reliance is a principal objective in the new contract relations being formulated in Peru and Venezuela.

## G. NEED FOR NEW INSTITUTIONAL MECHANISMS

Currently, the issue of technology transfer between U.S. and Latin American enterprises and specifically in Peru and Venezuela is beset by critical problems associated with a growing demand for new technologies and the inadequate U.S.-firm supply response. The authors believe that this situation will not be alleviated at least in the near future.

The underlying reasons for the inadequacy of U.S. response are:

1. The traditional sources of the bulk of U.S. industrial technology have been the larger-size firms (with sales above $ 100 million a year) who are reluctant to share technology on other than an equity investment or related licensing arrangements.

2. The medium to smaller size firms (with sales below $100 million a year) are not able to obtain financing for the outright sale of manufacturing know-how and related design-engineering services that are typically associated with industrial technology transfers.

It is for this reason that the authors intention in the final chapter of this thesis is to make:

1. An analysis of Peruvian and Venezuelan needs for new institutional mechanisms.

2. Specific recommendations for new institutional mechanisms to bridge these gaps.

# VI. GUIDELINES FOR TRANSFER OF U.S. TECHNOLOGY TO PERU AND VENEZUELA

## A. INTRODUCTION

The developmental objectives of Peru and Venezuela place strong emphasis upon continued economic growth and more equitable income distribution. A basic strategy to realize these objectives is through enhanced efficiency and competition to be achieved through technological upgrading of their industries. Another basic strategy is to intensify the exploitation of their mineral and energy resources. More equitable income distribution is to be achieved through purposeful efforts to further decentralize industrialization from the existing urban centers and to mount specific programs to increase income and employment among the rural and urban poor.

In order to accomplish the above developmental objectives it is essential to have an adequate Technology Transfer from the more developed countries. Peru and Venezuela traditionally have been influenced by the United States (cultural, economical and technological). Therefore, in this chapter the authors propose guidelines, initiatives, and mechanisms to facilitate the transfer of U.S. Technology to Latin America, and specifically to Venezuela and Peru.

## B. THE ECONOMY AND TECHNOLOGY

### 1. Technology Factor in National Development

Peru and Venezuela have reached a stage of social and economic development where substantial increases in productivity are needed in order to sustain economic growth. At the same time, unemployment problems and uneven income distribution necessitate substantial human and capital resource reallocation. Rural and urban poverty continue to be pressing problems. Government planners are fully cognizant of the need for a dual development strategy which increases productivity while increasing income.

The plan to balance income consists in part of decentralizing small and medium-sized industries into rural areas, thereby creating employment opportunities and raising income levels. Special emphasis has been directed to development of the agribusiness sector. Through tax, interest and exchange rate policies and related monetary measures government authorities hope to redirect previous policies, such as excessive import substitution, which have allocated resources inefficiently. Other assistance programs include efforts to upgrade output in agricultural regions and plans to encourage the proliferation of labor-intensive industries.

Efforts to increase productivity are linked to the structural transformation of Peru and Venezuela into urban,

industrial economies competitive in world markets. The financing of economic growth depends to a large degree upon exchange earnings from energy and mineral resources as well as the continued expansion of export and manufactured goods. One focal point of restructuring is the agribusiness sector with a view toward redesigning products and commodity processing to improve quality standards and efficiency for export markets.

Growth of export industries involves in part the extensive upgrading of technological capabilities through use of various financial and technical support measures. Long-term programs include plans for the development of new mineral and energy resources for export to strengthen Peru and Venezuela foreign exchange positions.

State-owned enterprises are spearheading development of Peru's copper, gold, silver, phosphates, iron, gas and petrochemicals industries as well as Venezuela's aluminum, iron, gold, gas and petrochemical industries, but both governments are also relying heavily upon the private sector to support expansion in these sectors. The latter will require economic incentives including favorable financial arrangements, to ensure an adequate flow of credit to the private sector, as well as augmenting the influx of private external capital. The development of technological absorptive capabilities and supply structures for the design

and engineering of production systems is part of the log-term growth objectives of the above mentioned countries planning authorities.

2. Sector Priorities

Mineral and energy resources development is considered to be a leading prospect for development. The dual aim is to effectively explore for and exploit oil, iron, copper and gas resources and to retain managerial control in national hands. This also applies to future mineral development. State enterprises have been negotiating "associated agreements" with U.S. and other foreign firms to provide exploration, mining and processing technologies. The main points of contention in the past over foreign involvement have been:

a. National participation in resource management.

b. The sharing of technical data developed in connection with exploration operations.

c. The training of nationals in the full range of technical-managerial tasks.

d. Pricing and profit-sharing formulae.

Peru and Venezuela do not have the exchange reserve position to replace foreign investment in the mineral and energy resource area. This has heretofore limited their bargaining position to obtain technology and managerial support.

Another priority development area is the export of manufactured goods, involving mostly medium-to-smaller-sized firms. The main obstacle is to upgrade product technical quality to permit entry to the more competitive world markets. These quality levels are not now required for the protected domestic markets in which most national firms have evolved. Present regulations governing technology imports in Peru and Venezuela are part of the Andean Pact. The latter sets limits on what can be imported and on levels of payment, and it compounds the technological development problems faced by industrial enterprises.

Foreign-owned firms bring technology with them and are able to bypass the payment restrictions that inhibit national firms, and thus placing the latter at a competitively disadvantageous position. The large native-owned and managed enterprises are in much stronger financial and technical position to develop or adapt product designs and adjust production methods to local needs and conditions than are smaller-size firms with limited financial and managerial resources and capabilities. Smaller-sized native owned firms have difficulties both in diagnosing their technical problem and in effectively carrying out appropriate action.

A third priority area is raising employment and income levels among the rural and poor populations. The

Peruvian and Venezuelan governments are particularly anxious to develop programs that raise productivity of low-income groups, and to assure maximum return of these gains to the poor. One possible approach is through the development of enterprises and income-earning projects that integrate the two dimensions of productivity gains and income shares. Such programs require adapting to the need and emerging capabilities of involved populations, appropriate training and technical assistance programs and supporting institutional networks.

3. Policies for Scientific and Technological Development

National science and technology policies and programs in support of economic growth and development have been influenced, in part, by the Andean Code. Its broad objectives are to reduce technological dependence on foreign sources through restrictions on foreign private investment, the national control of foreign licensing agreements, and development of indigenous technological acquisition and adaptation capabilities in support of national enterprises. The latter includes the support and development of national laboratory facilities and indigenous capital goods industries. Through the Andean Code, proposals have been made to create a central technology purchase agency supported by a regional science and technology information center. Other programs include the sponsorship of regional

development projects such as the processing of copper, the use of tropical forest resources and various projects of the petrochemical industry.

Intervention in an enterprise decision is regarded as a necessary step toward national technological development. It is generally believed that the only way to deal with the adverse effect of uncontrolled foreign technology acquisition is through the systematic control of technology transfer as recommended under the Andean Pact Code. Among the criticisms levelled against industrial technology acquired from foreign sources is that it:

a. Does little to resolve the problem of urban unemployment.

b. Tends to be capital-wasting as measured by the capital cost per job generated.

c. Contributes to further concentration of economic power in terms of the size of enterprise units and of income distribution efforts.

d. Fails to minimize use of imported materials.

## C. GUIDELINES TO PERUVIAN/VENEZUELAN POLICIES AND INITIATIVES

### 1. Measures to Consider

The various measures that Peruvian and Venezuelan governments may wish to consider may be broken down into functional groups:

a. To plan the technology component of product systems.

b. To conduct our own research, design and engineering functions.

c. To search and negotiate for technology from foreign sources.

d. To carry out technical supporting services and training.

e. To utilize acquired technology in terms of installation, operation, and maintenance of systems.

The previous chapter of this thesis has described the need to have a variety of institutional means to:

a. Restructure the supply of technology (largely through the screening and control of technology acquisition from foreign sources).

b. Restructure the internal demand for technology (through reinforcement of planning, searching and negotiating capabilities at the public institution and enterprise level).

c. Reinforce the absorptive infrastructure through training of key personnel in the use and generation of technology and related support systems.

The particular combination of measures Peru and Venezuela may chose to undertake will depend upon a broad variety of factors, including: the degree to which market mechanisms encourage and promote private sector initiative; and the effectiveness of existing institutional mechanisms involved in financial, research, and other support capabilities at the enterprise level, which constitute the critical link in technological development.

Both Peru and Venezuela have begun to move away from strong emphasis on screening and control of the supply of

technology from foreign sources toward more effective ways to reinforce the demand for technology.

This is in reference to the ability to search for and select technology among alternative sources and to negotiate on favorable terms for technology, and to reinforce technological absorptive capabilities at the national enterprise level.

National technological development objectives are increasingly focusing on the restructuring of effective demand for the technology component of productive systems to create or reinforce supporting infrastructure, such as design and engineering firms, technical research institutes and laboratories, and capital goods industries that can design and manufacture machines and equipment more suitable to these countries emerging needs and conditions.

Technological capabilities to reinforce the absorptive infrastructure vary widely and are far more difficult to manage than the creation of screening and control mechanisms. Development authorities in Peru and Venezuela now perceive that the major obstacles to technological self-sufficiency lie not so much in knowing what they do not want and keeping it out, but in knowing what they do want and need, and how to acquire it on favorable terms and use it effectively. National legislation and budgeted expenditures have not proven to be the most

effective means for achieving desired results. The principal infrastructural deficiencies in Peru and Venezuela relate either to shortages in trained technical personnel and/or to inadequate linkages between research communities and productive enterprises. Both countries are relatively well endowed in technical and entrepenurial capabilities at the enterprise level but inmense unemployment problems pose a unique set of pressures on the economy to upgrade technological absorptive capabilities so as to accelerate growth, create jobs, and generate income.

The major means for implementing technology programs have been:

a. The use of state enterprises in basic industries.

b. Government funding of science and technology programs.

c. Financial mechanisms in support of technology objectives.

d. Government controls over international transfer of technology.

In the case of Peru and Venezuela, the institutional means to manage technological development are as follows:

a) Restructuring the Supply of Technology (Screening and Control): Decisions 24 and 85 of Cartagena Agreement (ANCOM) regulations.

b) Restructuring the Internal Demand for Technology (Planning, Searching, and Negotiating): Evolving capability in energy and mineral resource management.

c) Reinforcing Absorptive Infrastructure for Technology (Training, Supporting, Using, and Generating):

1. Generating agreement designs to upgrade absorptive capability.

2. Encouraging evolution of capabilities among small-to-medium enterprises.

2. Negotiating for Technology Acquisitions

The ability of Peruvian and Venezuelan enterprises to negotiate advantageous technology-sharing agreements in identified opportunity areas will depend upon:

a. The bargaining leverage and enterprise strategies of the technology supplier.

b. The bargaining leverage and enterprise strategies of the technology purchaser.

c. The supporting programs and policies of the purchaser government.

d. The distinctive characteristics of the transferred technology.

For the process of negotiation for technology acquisition the authors have summarized the factors covered in Chapter IV, and in this Chapter, in the following model as an analytical framework for technology sharing by U.S. based multinationals with Peru and Venezuela:

a) Technology Supplier

1. Bargaining Leverage

- Competitive world market position.

- Technological lead.

- Negotiating astuteness.
- Financial resources.

2. Enterprise Strategies
   - Returns from technology sales provide funds to maintain technology lead.
   - Continued access to lucrative market.
   - Possibility of future low cost procurement source.
   - Continued access to scarce resources.

b) Technology Package

1. Distinctive Characteristics
   - Size and complexity.
   - License to manufacture or turn-key-plus.
   - Operative, duplicative, or innovative characteristics.
   - General, firm, or system-specific stage in product/process cycle.
2. Supporting Government Policies
   - Screening and control mechanisms.
   - Technical support networks.
   - Acting as the negotiation and purchasing agent.
   - Infant industry protection.

c) Technology Purchaser

1. Bargaining Leverage
   - Reinforcing government support.

- National resource endowment.
- Financial and foreign exchange.
- Attractive national market.
- Technological absorptive capabilities.
- Alternative sources of technology.

2. Enterprise Strategies
   - Obtain internationally competitive technology.
   - Entry into export markets.
   - Fast, efficient technology transplants.
   - Duplicative and/or innovative design and engineering capabilities.
   - Training of technical-managerial manpower.

Possible commercial, technical and financial strategies motivating the supplier enterprise to share technology, along with the various elements which contribute to its bargaining position, are listed in the "Technology Supplier" aspect of the model. Similarly, purchaser strategies and sources of bargaining leverage are listed in the "Technology Purchaser" aspect of the model.

The ultimate viability and success of any technology transfer and implantation depends heavily upon the level of support extended by the government to the purchaser enterprise. There has been an increasing determination on the part of the Peruvian and Venezuelan governments to intervene in the negotiation process to assure favorable

contractual terms for national enterprise and to provide further reinforcement in the implantation stage. Included here are:

a. The protection of infant or national industry against foreign imports.

b. Provision of technical support networks and institutions to assist the purchasing enterprise in the production and marketing function.

c. Making available necessary credit and foreign exchange needed to purchase equipment and expert training programs.

The potential value of a technology package to a purchaser and the adjustment problems it poses are a function of the distinctive characteristics of the technology supplier. The authors have listed some of these major characteristics of technology in the "Technology Package" section of the model.

Elements of the technology package which include technical data and human skills, are conveyed through an interactive process of adjusting implanted producers and equipment operation until the desired production efficiencies and quality standards are achieved.

The effectiveness of technology transfers depends in large part upon the absorptive capablities of the recipient enterprise and the industrial environment in which it operates, and to a lesser extent upon the transfer capabilities of the technology supplier. A basic reason for acquiring technology from another enterprise, rather than

through one's own research and development, is that it is generally much cheaper and quicker. This is the reason why technology has become a "commodity" in world trade.

Another critical aspect relevant to international technology transfer is the distinction between implanting "operational" (turnkey) technology and imparting technical capabilities to duplicate that technology, which, in some cases, may lead to an indigenous capability to design and engineer industrial systems. The Japanese have been particularly successful in using licensing arrangements as stepping stones to self-sufficient technological capabilities, which were eventually used to develop new generations of internationally competitive products, processes, and production systems. Achieving worthwhile results in the latter area depends, in part, on the state of development of the recipient enterprise and supporting industrial sectors.

## D. INSTITUTIONAL MECHANISMS TO FACILITATE TECHNOLOGY TRANSFER

### 1. Technology Transfer Corporation (TTC)

A major deficiency in the U.S. - Latin American technology transfer is the lack of appropriate financial mechanisms to bridge the gap between would-be (U.S.) supplier firms unable or unwilling to become venture capitalists and Latin American enterprises seeking

technology packages which will meet the new sets of national goals for technological development and which will increase capabilities to diagnose technological adjustment problems and participate in the adjustment and absorption process at the enterprise level.

Most of the technology acquired by Latin American enterprises from United States sources has been under investment and licensing arrangements with U.S. firms. Most of these are subsidiaries or joint venture companies. As can be observed, the demands for technology have far exceeded supplier response for a number of fundamental reasons relating to the expanded role of the technology factor in development.

One of the reasons why the supply of technology from American enterprise sources has been restricted is the fact that only a limited number of U.S. firms are in a position financially, and from a risk taking standpoint, even to explore business opportunities in Latin America, let alone to pay for technology transfer costs well in advance of realized earnings. It may be several years before an overseas business venture in a developing world country breaks even and begins to yield a return. Even under licensing arrangements without equity involvement there are the risks, uncertainties and time delays associated with royalty payments. Few licensor firms are in a position to

incur the additional costs of technical support services that may be associated with the successful implant of operationally efficient industrial technology. These additional costs involve adjustments in product designs, production engineering, and in manufacturing practices, which are typically required for particular market conditions and operational environments.

Another factor inhibiting technology sales is the reluctance of most banks to finance the "intangibles" of technology acquisition (design, engineering, training, and related manufacturing implant services) on both the purchaser and supplier sides. Neither private commercial banks nor government-sponsored development banks are willing, or in some instances able, to lend for local enterprise expenditures on technological upgrading. A new set of financial mechanisms are needed which can accommodate the categories of expenditures for "intangibles," apart from the sale of capital equipment and for similar five-year terms.

On the other hand, the United States commercial banks and the Export-Import Bank, by and large, do not provide the short-term and medium-term supplier credit needed for the type of technology transfer contracts generally sought by Peruvian and Venezuelan enterprises, and of course, by almost every Latin American enterprise.

Shortcomings and deficiencies in this regard are delineated as follows:

1. A fundamental problem is that most U.S. commercial banks are much more conservative than European or Japanese banks in extending credit for foreign trade. Their conservatism extends back to the U.S Government-sponsored mechanisms intended to promote export trade by the Export-Import Bank and the associated Foreign Credit Insurance Agency.

2. The above mentioned financial conservatism is especially pronounced when it applies to lending for service intangibles, except where sales are associated with the export of equipment and/or connected with large scale construction projects. The reluctance to lend for these purposes is traceable in part to difficulties in the defining and pricing of services and in certifying delivery and adequate performance under such contracts.

3. The size of loans associated with technology transfers are small relative to machine and equipment purchases, and the vetting of these contracts is more complicated. Both of these factors contribute to increased unit overhead costs for loan processing, and therefore commercial banks tend to shy away from them.

The central objective of the proposed TTC (Corporacion para la Transferencia de Tecnologia) would be to expand involvement of U.S firms. It would be designed in such a way as to accommodate the widespread demands in Latin America, and other developing world nations, for manufacturing know-how and related design engineering and other technical support services without the management and control normally involved in foreign investment by large multinational firms.

The TTC would provide growth opportunities to a broad spectrum of U.S. firms. Many of these firms are in

need of financial resources to upgrade and expand existing production lines which are no longer internationally competitive, and they can use these additional earnings to reinforce and to upgrade existing plant and equipment.

The proposed TTC is conceived as a small, autonomous group organized as a joint corporation with members from the United States and the countries involved in the Technology Transfer process in order to promote, finance, and help implement technology service exports. The TTC would operate initially in selected projects, under cooperative agreements negotiated with appropriate development banking intermediaries. These cooperative groups would:

a. Determine technology survey requirements.

b. Develop project profiles of technology requirements.

c. Determine credit worthiness of local enterprise groups.

Among other functions, TTC would:

a. Translate these requirements into cost estimates for required services.

b. Identify and select suitable U.S. enterprise candidates to supply the required technology transfer services.

c. Make arrangements for field visits by U.S. firms to complete contract arrangements.

d. Arrange for financing of project.

2. Small Enterprise Development Corporation (SEDC)

Urban and rural poor communities face particularly difficult, and often intractable circumstances when it comes to improving their economic conditions. Too often, overall industrial expansion does little to benefit them through increases of jobs, income, and needed goods. The establishment of new enterprise forms, including self-managed enterprises may be one way to give the poor new access to decision-making and control of the means of production, and consequent income-earning opportunities.

In other cases, it may prove possible to link together small-scale enterprise or artisan groups to achieve economies of scale in purchasing, marketing, distribution, storing, bookkeeping, and for other legal/technical/management services. These new enterprise forms could reach large numbers of people with greater effectiveness from a social development point of view. These various new enterprise forms could provide additional opportunities to increase productivity among this group of income earners and to increase their share of income from value added in production units.

A Small Enterprise Development Corporation (Corporacion de Desarrollo de Pequenas Empresas), specially staffed to reach into the sub-cultures of poor populations, with an appropriate line of credit, may be one means to

improve the earning power and security of the poor. Traditional credit institutions, even those oriented to small-scale enterprise, are ineffective in this area.

They are unable to assist in the indispensable task of project formulation that an SEDC would be staffed to undertake, and are either unable or unwilling to administer the large number of small loans for numerous small projects that are typical in this sector. Development banks generally are unwilling to take the inevitable risks that characterize this area. Special skills will be required to start these projects and to monitor the experiments, until they reach a point of viability, especially self-managed projects.

The SEDC with a structure similar to the TTC, would operate as an autonomous public corporation with funding from national and international sources. Its functions would be:

a. To develop access and ties to urban poor communities, with a view toward involving them in project formulation and other steps in the decision process.

b. To establish appropriate linkages with public agencies (national and international) that could provide funding, programming or technical support.

c. To identify and help formulate projects for the poor.

d. To establish liaison with local agencies and groups that can assist in project formulation and execution-including training, technical support, appropriate technology design, marketing, and other necessary ancillary support services.

e. To monitor funded projects with a view toward improving the impact of lending.

f. To help syndicate loans with other lending institutions for projects that have passed the incubation state.

## VII. CONCLUSIONS

At no time in history has the human race been presented with a challenge of the magnitude and complexity as the one we are facing today, in a world where technology is a dominant and primary factor.

Therefore, since we have no new frontiers to conquer we must make the most efficient use of all the available natural resources to support the needs and demands of our countries.

The only way to reach an acceptable standard and to comply with the developmental objectives of Peru and Venezuela is by means of an adequate and aggressive technology transfer process primarily from the United States which is the most developed and influential country on the American Continent.

As has been established, there is a strong need to review the actual policies and procedures regarding the Technology Transfer process in order to utilize the Technology factor as a pivotal element of national economic growth and development.

Part of the problem that is being faced is the lag in perceptions of a changing world. There is also a reluctance on both sides to face up to the reality of change and to

accept the necessity to reconcile differences if mutually destructive conflicts are to be avoided.

The basic purpose of this thesis has been to provide insight and guidelines leading to practical arrangements that will contribute to conflict resolution. Hopefully, these suggestions will lead to realistic accommodations of technological disagreements between the United States and Peruvian and Venezuelan governments and enterprise that apply also to Third World countries.

It is the authors expectation that the proposals made for institutional arrangements should prove to be useful in moving toward mutually advantageous courses of action rather than continuing recriminations and mutually detrimental behavior.

An additional note is worth remark. In the future the research presented in this thesis, could be expanded through the detailed study of the development and organization of the proposed institutional mechanisms (Technology Transfer Corporation and the Small Enterprise Development Corporation), and its application to both, the civilian and military fields.

As the famous French general Charles de Gaulle once remarked, "On s'engage, et puis on verra."

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